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MENTAL LIFE OF TWO *MACACUS RHESUS* MONKEYS IN CAPTIVITY.—II.

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NUMBER TESTS.

There has been considerable written and but very little done toward a rigorous examination of the number notions of lower animals. Stories of their wonderful achievements in counting and comprehending numerical relations are abundant. For example, it is said that shepherd dogs count sheep. One drove sheep to the wash in groups of ten each. Bird dogs are said to count the number of birds that fall when the master fires. One dog counts the railway stations when on a train, and so knows where to get off. Another displayed "thorough proficiency in the first four rules of arithmetic," barking off the answers of the problems put to him. A mouse came nine times to carry away each time one of her young handed to her from a cup, and did not return after the last was taken.[1] A Cincinnati mule counted fifty.[2] A dog counted her six puppies and knew when one was missing. Leroy reports a crow that counted four. One of the nearest approaches to real counting appears with some insects. A species of wasps, the Eumenes, supplies for its prospective young five victims for each egg laid. Other species with constancy supply ten, fifteen and twenty-four. When the regulation number has been put in the wasp stops even though some of the victims may have been stolen in the meantime. Again it is said that the Eumenes supplies for each male egg five and for each female egg ten victims. This looks

[1] Lindsay, Vol. I, p. 451.
[2] Weir: Dawn of Reason, p. 173.

very much like counting on the part of these insects. On the part of monkeys it is said that the larger apes will approach two or three men, but will not attack a larger number. Monkeys have been taught to hand up one, two and three marbles or straws when these numbers were called for.[1] Possibly all of the above cases were mere associations with quantity, and that the number idea as such was wholly absent.

I am not aware of any very systematic attempt to test the number sense in the lower animals. Mr. Garner made a few tests with monkeys, using marbles, from which he concluded that the monkeys knew clearly the difference between two and three. He presented two plates, on one of which were placed three cubes of carrot or other food; and on the other, one. The monkey tried to get the food from the plate containing the greater number. It is probable that quantity was more the basis of choice than number. Yet when one piece was increased in size the monkey still tried to get the two. Next he put three marbles into a box having a hole in one side of it. After the monkey had taken them out one at a time, for several times, he then put only two into the box. The monkey felt in the box, and then looked around where he had been sitting as if to find the missing marble. While Mr. Garner was well satisfied from these tests that the animal could distinguish number, these cases are easily explained on the basis of association and suggestion.

I was unable to make tests similar to Mr. Garner's with the *rhesus* monkeys because they were so wild and did not engage in play. I have tried to approach the question, however, in another way. I devised a special apparatus with which I made 2,790 tests with the male, 1,260 with the female, and 140 with two children. These, like the experiments of others, can hardly be said to test the ability to count or to comprehend number, but the reactions were so unique that it seems worth the while to report them rather fully.

The apparatus used consisted of a board 2½ inches wide and 10 feet long. Twenty-one uniform wide-mouthed bottles (or for the female, glasses) were set on the board four inches apart. The bodies of these bottles were covered with white paper to prevent food from being seen except from immediately above. In experimenting I set this board down at right angles to a line from the monkey to the middle of the board, and then stepped back from three to six feet. After a few tests had been made it became apparent that it would be most convenient to make one presentation in the south and one in the north end of the room. The position of the apparatus varied

[1] James Weir: Dawn of Reason, p. 177.

from time to time in each end of the room about ninety degrees in the angle of placing, and from a few inches to four or five feet forward and backward and from right to left.

The male was experimented with first. Food was put into the fourth bottle from each end of the board. By mere chance he first fell upon the food in the bottle on my right. In all the succeeding experiments only the right end of the board was used. The male was tested with eleven food bottles in the following order, counting from the end of the board to my right, 4, 2, 5, 1, 6, 9, 11, 8, 3, 10, and 7. In the accompanying table all above six are omitted, so the table gives the order 4, 2, 5, 1, 6, 3, which was the order followed with the female. The female was tested with no numbers higher than six. The numbers in the first column at the left indicate the numbers of the bottles or glasses used, counting from the end of the board to my right as I stood behind it. The numbers in the vertical columns following this indicate the number of times that each of these vessels was approached directly by the monkeys in a series of thirty tests. The number of times that vessels above the 7th were approached directly are thrown together in the table as "over 7." These tables take no account, again, of the bottles or glasses looked into after the one approached directly. The results from feeding the male in 7, 8, 9, 10 and 11 are not shown in the table.

The accuracy of selection could not be due to accidental markings on the vessels. For after accuracy was established I exchanged the food vessels for vessels taken from the other end of the board. These exchanges caused no apparent disturbance in the accuracy of choosing. It is interesting to note how gradually the burden of his choice swung up and down as the food was changed from one bottle to another. For example, I will give rather fully the changes when the male was fed from bottle 6. Note that he had been fed previously in 4, 2, 5, and 1. (1) In the first and second tests he went directly to 1, then examined all of the bottles up to 6. (2) With the third test he began going to 2 and 3, and then looking into the bottles back down to 1 and then up to 6. (3) With the 10th test he began going to 3 directly then to 2 and back to 6, thus neglecting the return to 1. (4) With the 16th trial he began going directly to 4, tracing down to 2 and back again to 6. (5) With the 27th trial he began going directly to 4, then looking into 3 and returning towards 6. (6) With the 42nd test he began with 4, and then took 5 and 6, leaving off all of the lower numbers. (7) With the 44th test, 5 was approached directly for the first time. (8) With the 53rd test he went directly to 6 for the first time. (9) With the 91st test he began choosing some numbers higher than 6.

There were, of course, numerous relapses after each one of the beginnings noted above. With the 90th test experimenting closed for the night. The next 30 tests show scattering choices as a result of the intermission. Bottle 1 was never chosen directly after the 9th test; 2, but once after the 13th test; and 3, but once after the 133rd test. The effects of these over-night intermissions are apparent in the table for the male. With food in 2 it appears in the seventh thirty; with the 5, in the fifth 30; with the 6, in the fourth 30; and with the 3, in the seventh 30. The over-night intermissions were avoided with the female.

One, two, five and six were definitely located, while three and four were always over-estimated. On the whole four was greatly over-estimated by the male. Only 22 times out of the 270 trials did he go directly to numbers below four, while he went directly to numbers above four 187 times, and directly to four 61 times. Three had 22 choices below it, 129 at and 149 above it. The apparatus was new for 4, while 3 was approached with considerable experience. Yet three had been preceded by feeding in 9, which would tend to induce over-estimating it. I was unable to note any irregularities in the condition of the animal or method of work that would account for the comparative failures with 3 and 4 followed by rather successful associations with 5 and 6. The choosing of 5 so often when I was feeding him from bottle 4 almost led one to believe that if the experimenting had begun with 5 instead of 4 he would have chosen it more frequently than he chose 4. Yet this is only a surmise. With 5 he selected lower numbers more frequently than higher ones. With 6 the former feeding bottle favored the selection of lower numbers. The table and the above analysis both show how he was affected by this fact. In all the higher numbers the choices fall mostly below the number of the food bottle. Thus, 7 was chosen 72 times with 8 choices over 7, and 220 choices under 7. Eight was chosen 127 times with 50 choices over 8 and 93 choices under 8. The choosing level was here lifted up by the fact that 11 had immediately preceded it. But the number of direct choices of 8 decreased, as did also the over-choices, as the experimenting progressed. Nine was chosen 25 times with 4 choices over 9 and 271 choices under 9. It had been preceded by 6. Ten, preceded by 3, had 1 direct choice, 2 over choices and 297 under choices. The center of choices for 10 fell with number 7, as it did also for 9. Eleven was preceded by 9. Its predecessor, therefore, lay closer to it than did that of 10. Eleven had 15 direct choices, 1 over choice and 194 under choices, while the main body of choices lies with 10. Four and five then seem to be a turning point in his reaction to this apparatus. With 4

MALE

Numbers of Bottles	Food in Four									Food in Two										Food in Five										Food in One					Food in Six										Food in Three									
1	1													1																		17	25	3																					
2										1	3	5	9	9	3	1	1	23	25	4	1										5	12	5	5			1							1		2	6	3	1	2	1	3
3		1	4	2			7	5	2	10	14	14	12	16	22	7	19	7	5	8	9	6		2						12	22	1		17	7	5	4	3	1					1	8	9	13	15	14	13	20	17	19
4		5	5	6	6	9	8	12	10	10	8	10	5	5	5	19	9			8	16	15	7	13	5					13	2			5	17	7	16	6	2	2				4	11	11	12	8	13	12	6	9	8
5		10	10	7	15	15	8	9	12	4	5	1	3			1	1			7	1	8	18	13	20					5	1				5	15	7	10	8	12	8				7	7	9	3			2	1	2	
6	1	1	9	11	8	5	7	4	4	3						1				2	2	1	5	1	5									1	3	0	9	15	12	26				13	3	1				1	1			
7	3	6	1	4		1			1							1				1	1			1												1	2	4	3				2										
Over 7	25	7	1		1				1	2																											1			1	1		3										

FEMALE

Numbers of Glasses	Food in Four						Food in Two						Food in Five												Food in One			Food in Six																Food in Three										
1	6	3	1	1	1		3	8	5	1	4		2					1							1	11	25	2														1	1									
2	4	4	1	3	4	12	14	14	21	21	19	26	9	1		1	2	3	2	3	2					10	5	1															3	1	3	5	5	8	4				
3	3	9	11	5	8	12	9	6	4	8	7	4	15	21	11	6	13	6	6	8	8	3	16	8		7					2			3	2	7	17	18	12	19	23										
4	5	4	11	14	13	5	3	1					2	8	11	13	11	10	17	10	9	11	9	1		4		1		1	1	3	1	2	9	14	7	7	13	3	3									
5	7	8	2	1	3	1	1						2		6	3	3	7	3	8	9	12	3			5	5	3	1	1	4	3	3	5	5	13	5	3												
6	2		4	3	1			1							2	2	1	2	2	1	2	4	1			2	6	6	7	8	7	10	10	12	14	1	1													
7		1		1																						7	9	4	8	12	8	9	7	9	4	1														
Over 7	3	1		1														1								2	10	16	14	9	10	5	5	3	2		1													

and lower numbers he inclined to choose higher numbers than the food bottle; above 4, lower numbers were chosen. While numbers were learned up to six, 3 and 4 were beset with special difficulties. Three was more definitely recognized than 4. One and 2 gave comparatively little difficulty, and in the case of 4 it may be that the confusion arose out of the fact that it was near this turning point of approach.

With the female the tables of results show less capacity than with the male, but a more ready association for the numbers that she was able to comprehend. Thus, when the food was in 1, the male chose correctly only 17 times in the third group of 30 tests, while the female chose correctly 25 times. He chose two three times in the sixth thirty; she chose it 26 times; he chose three 13 times in the seventh 30; she 23 times. So far she chose better than he did. Above 3 his superiority for the number idea, if indeed it be number, is very apparent. He chose four 9 times in the sixth thirty; she chose it only 5 times. He chose five 20 times in the the sixth 30; she only 7 times. He chose six 26 times in the eighth 30; she 11 times. It was thought unnecessary to try her further. Five was as difficult for her as seven for him. She learned no number above three with any degree of certainty. The male learned six as perfectly as the female learned three. His central number space from which he appeared to work down to a lower and up to higher numbers was between four and five, hers was between three and four. But she introduced a variation with six. Here she cast most of her choices above the food glass. Thus with her 1, 2 and 3 are apparently numbered, or at least recognized definitely. Four and five are quantities just to be estimated. With the male 1, 2, 3 (4?), 5 and 6 are definitely recognized numbers, while all beyond these are an indefinite great many. We may conclude that these two animals with this apparatus were able to recognize numbers from 1 to 3 and from 1 to 6 respectively.

Two children, aged 3 and 5, who had not been taught to count, were brought before this apparatus under conditions as nearly as possible the same as those for the monkey. Marbles were used instead of food. The older child located 1, 2 and 3 perfectly, but could not make sure of higher numbers. It is possible that he could have succeeded with others if experiments could have been continued without fatigue. The monkeys apparently never fatigued no matter how long the experimenting was continued. This child early resorted to noting the spatial location of the glass containing the marble, and attempted to return to that place in the room. He was not allowed to take the marble unless he came directly to the glass containing it, but in case he missed it he was allowed to look

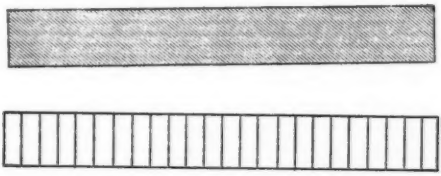
along the row of glasses and to see in what glass the marble was to be found. As he returned to his mother at the other side of the room the apparatus was shifted to a new position. When he began trying to locate the glass in this way he was told that the apparatus would be moved, and arrangements were made for sliding it over on to a second table. The three year old child learned 1 and 2 perfectly. Three was more difficult, and the child failed with larger numbers. Thus the monkeys appear in this particular to attain in one year to a development attained by human beings in from three to five years. But here monkeys ability to comprehend numbers and number relations probably reaches its limit, while the human being goes on not only to a comprehension of larger numbers but learns to deal with numbers both abstractly and symbolically.

But what is it that the monkey and children recognize here? Is it number, quantity or form? Lubbock would have it that in all such cases as mentioned at the beginning of this section, which closely resembles those with the monkeys and children the animal does not have a number idea, but an impression of greater or less quantity. It could hardly be maintained that these monkeys and children counted the glasses or bottles in order to determine which one contained food. With the larger numbers clearly selected one could see the eyes of the monkey give a quick movement along the line. The movements were not those of stops and starts. Roughly estimating I should say that the glance did not occupy more than one-fourth of a second. The appearance was merely that of sizing up of the quantity. Ribot[1] seems to express the process exactly when he is discussing Leroy's report of the crow. He says: "I see here not a numeration but a perception of plurality, which is something quite different." Of this process he adds, "it is a preliminary state, an introduction, nothing more, and the animal does not pass beyond this stage, does not count in the exact sense of the word."

Lloyd Morgan[2] has dealt definitely with the case in hand. He says: "The raw materials of numerical relations, as of those of space and time, are given in our daily experience, and are marginally sensed long before they are focally perceived. The child, long before he can count, senses the difference between one thing and two things, between two and three, between three and several, between several and many. It would not be surprising to find that a clever dog was able to distinguish from each other playing-cards, from the ace to the ten. But they would be distinguished through difference of sense-impression,

[1] Evolution of General Ideas, Chicago, 1899, p. 21.
[2] Introduction to Comparative Psychology, London, 1900, p. 232.

not through perception of numerical relations. So, too, with succession. One can very readily distinguish a succession of three from a succession of four, without anything like counting, through the sensing of sense-experience. It is, indeed, surprising how large a group of sounds, up to sixty-four in my own case, can be appreciated without counting. But the perception of numerical relations is something more than the sensing of a group of discrete objects or sounds. It is also to be distinguished from the perception of the group as larger or smaller. Whether the numerical relations were first perceived among objects simultaneously presented, or in association with succession, we cannot say; but it is at least possible, if not probable, that they arose in close association with that phase of time-experience which presents us with succession rather than duration. Run the eye slowly from left to right along the shaded diagram. You are subconsciously aware of the duration of the impression it produces. But if you run the eye along the second figure you are aware of succession.

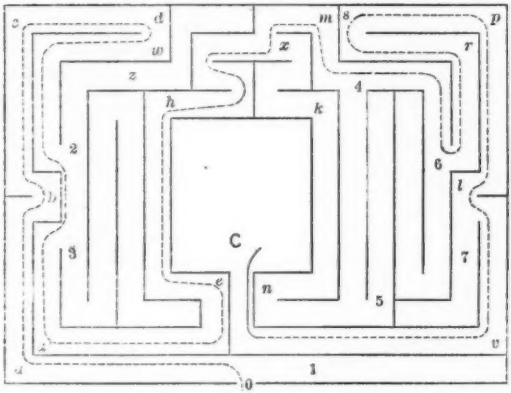


The homogenous duration of a continuous impression gives place to a successive series of similar impressions. And in this series you have not only one aspect of time-sequence, but also the material form from which a numerical-sequence may, on the advent of reflection, be evolved." This appears to be what the monkeys and children did in their reactions to this apparatus. The numbers 1, 2 and 3 were clearly discriminated, while 4, 5 and 6 were seen as a somewhat definite mass. Beyond these we have only an indefinite mass or group but no measured quantity.

Reaction to a Maze.

The maze used was identical in form with that used by Dr. Willard Small[1] and I am indebted to him for the use of the accompanying cut. My maze was, however, of necessity much larger than his, being 17 feet long, 13 feet wide and 14 inches high. The alleys were 1 foot wide. The whole was built of "chicken wire" fastened to wooden frames. The central por-

[1] *American Journal of Psychology*, Vol. XII, Jan., 1901, p. 207.



tion was not covered, so that when the animal procured his food, which was put in the middle of this central portion, he was free from the maze and could return to his cage. The entrance was at *o*. Numbers 1-7 indicate the blind alleys. The dotted line shows the most direct course through the maze.

The sources of error, on the part of the animals, were the blind alleys and return movements along the direct course. In keeping the records, entrance into a blind alley was always called an error. Also, if the animal proceeded to any point in the direct course, then returned any distance in this course, turned about and proceeded correctly thereafter, he was recorded as having made one mistake no matter how great the return movement. If, for example, he proceeded to 3 and returned to *a*, this was counted as one error. If he entered 3 and returned to *a* this counted for two errors, one for entrance into the blind alley and one for failure to take up the proper course as he came out of it. Entrance at 4 was arbitrarily counted as an error, while a trip through *xkn* was not so regarded as that merely represented a longer course to the goal than proceeding by way of *m*. The shortest path from the entrance to the food was 105 feet, and there were 27 corners to be turned.

Method.

After the cage had been brought up to the entrance of the maze, the monkey was allowed to see some food placed on the floor in the middle of the open center. The door of the cage was then lifted. The monkey invariably rushed at once into the maze. Printed forms, identical with the accompanying cut, were used for keeping the record of movements, while the time

was kept with a stop-watch. I took up my position behind the cage and opposite *o*. This brought the maze in full view, and allowed the monkey to see me from any part of it. While he moved I traced his path on the forms indicating stops and the number of seconds required to reach any given portion of the maze along with the time spent in resting.

As soon as the animal had procured his food the cage was turned partly around and the door opened. After a few times he learned to go immediately across the maze into the cage, even while I held the door open. On beginning it was decided to regard the maze as learned whenever the animal succeded in passing through it ten times consecutively without error. The male reached this standard with the 113th trip, and the female with the 66th.

Analysis of Results.

In their native habitat these monkeys are accustomed to weaving their way through the boughs of trees and along winding paths of the bamboo thickets.[1] Their native haunts in a very general way at least are like the maze. They showed no fright at being confined in it and my presence near the maze (I was about ten feet from it) did not seem to annoy them in the least.

In the first tests if a blind alley was entered it was pursued to the end. Then the monkey seized the wire and shook it, looked about awhile and returned. Later when alleys were entered there was no shaking. He either sat as if trying to determine his proper course or turned about quickly and came away. After an alley had been entered several times it was pursued only a short distance. They were entered and left at about the same speed. The hasty glance, when blocked in an alley, followed by the return movement, gave the animal very much the appearance of saying "Hold up! No, that's wrong. Well, I'll go back."

In the accompanying table the figures in the first horizontal line indicate the number of the trips through the maze. Twenty trips for each animal are shown. The items in the column at the left will be readily understood by reference to the preceding cut.

A successful passing of a blind alley (4 has been counted here as a blind alley) is indicated by leaving the space blank.

[1] Kipling says in his Jungle Book, p. 57, that the flight of the Monkey People through tree-land is one of the things nobody can describe. They have their regular roads and cross-roads, up hills and down hills all laid out from fifty to seventy or one hundred feet above ground, and by these they can travel even at night if necessary. This is quite a correct description of their habits.

Parts of the Maze, etc.	MALE																				FEMALE																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Entered Blind Alley 1	4		5	1	5	1	2	3	1	1					1				1	1	4	3					1	1	1	1										
a, Passed	12		12	2	3	2	4	4	4	2	2				2				2	2	8	18					2		2	1	2									
b, Passed	12		8	2	10	2	6	4	4	2	2				2				2	2	3	24					2	2	2		2									
c, Passed	10	2	6	2	8	2	6	4	4	2	2				3				2	2	8	22		2			2	2	2		2									
w, Passed	16	4			6	4	6	4			2				2				2	2	2	14		2			2	2												
Entered Blind Alley 2	8							2													1	5		2			1	1				1		1	1	1			
Entered Blind Alley 3	11	2	1				1	1										1			2	8		1		2	1	1			1		1						
e, Passed	2	4			6	2	6	2		2											24	2	2	2	2									2					
e h, Traversed	30	12		1	16	4	8	2		2	2										2	30	2	2	2	4													
x, Entered		3			2	5	1	3	1												1	13																	
kn, Traversed	2	16	3	5	23	3	7	2								2					7	30			1														
Entered Blind Alley 4		2	1	2	3				1	1	1	1		1		1	1				1	11	1	2	2	1	1												
" " " 5			3		1	3		1							1						1	5	2		1	1													
" " " 6	6		1	1		1			1	1	1	2	3	2	1	1	2	1	1	1	1	4	1	1	1	2	1	1	2	1	1	1								
r, Passed	6						2				2	2	6	2															4	2	2									
p, Passed	2				2		2									2					2	2	2						2											
Entered Blind Alley 7	2						1	2				1				1					2	1	1																	
To r and Return	1				1																																		
Times in Seconds	720	420	140	900	230	300	285	160	204	107	100	83	61	67	43	60	30	66	41	420	720	840	420	375	420	210	105	165	130	250	124	76	164	43	175	194	110	138	94
Errors	56	32	15	8	32	6	15	11	4	6	3	4	4	2	3	4	4	2	1	23	76	9	11	5	7	5	5	3	3	2	2	0	4	0	1	1	2	1	0

The figures indicate the number of times that any point was passed or any alley was entered by way of error. Some short return movements between the letters on the cut could not be presented in this table. Also many return movements along

the direct course passed several of the points designated. Hence, often the total number of errors given near the bottom of the table does not agree with the items of error in the body of the table. It will be seen that the errors decreased very rapidly after the second trial, and that the female was the slower at first, but surpassed the male in her fifth trip. For her first trips she required the longer time, but he made more than twice as many errors as she did. His movements were much more rapid than hers, and she spent by far the greater amount of time sitting around with folded hands.

Alleys 1 and 6 persisted longest, while 2, 5 and especially 7 were soon eliminated. Yet relapses sometimes set in where a part had been passed successfully a great many times. The tabie shows that the male learned the last part of the maze first, but suffered considerable relapses with the 11th, 12th, 13th and 14th trips. The middle part was well learned in the tenth trip, while in the first part of the maze serious relapses occurred after the 12th. With the female we find the same order, but the parts were mastered more readily. In her 13th trip she went through without error, but the male did not meet with similar success until his 36th trip.

Comparing the two in the accompanying table of average times and errors it appears that the female has accomplished much more than the male. She learned the maze in 66 trials, while he required 113. His movements being much faster than hers he attained to an average time of 44.8 seconds, while her average never went lower than 55. But when in the maze neither ever went faster than a brisk walk or "dog trot," though, as with Mr. Small's rats, this gait was hastened toward the last of the journey. The increase in speed, however, was not very great, and was rarely begun until after *p* was passed. When the latter part of the maze was fairly learned, the monkeys often after passing *r* would begin to smack their lips audibly, apparently at the thought of the food. In their earlier trials as they passed from *e* to *h* they stopped to look at the food, and often attempted to reach it, but after the first few trials no effort was made at shaking the wire or reaching, and often they did not even look toward it.

The feeling of uncertainty manifested itself with the male at *m* and 4. Coming from *n* up through 4 he would not turn toward the exit, but would proceed to *m* and then face about and continue correctly. The male repeated this movement ten times. The female showed signs of similar indecision by half body-length movements into 3, 4 and 6, and three times by turning completely around when passing 4. Often there was a mere hesitancy at 4 before continuing the trip. On entering the maze the first time the animal's first move was to get nearer

MAZE RESULTS.

		1st–10	2nd–10	3rd–10	4th–10	5th–10	6th–10	7th–10	8th–10	9th–10	10th–10	11th–10
Average Times in Seconds.	MALE.	726.9	73.7	76.	64.4	61.2	67.2	53.8	46.6	44.8	45.4	59.5
	FEMALE.	2579.	127.7	63.6	68.1	55.8	55.					
Average Errors.	MALE.	18.5	3.1	3.2	2.2	1.4	2.6	1.5	1.6	1.2	.7	.4
	FEMALE.	14.1	1.3	1.7	.7	.4	.3					

The consecutive trials have been thrown into groups of ten each. The numbers in the vertical columns indicate, respectively, the average times and errors for the corresponding groups. The last three trials for the male and the last six for the female are not accounted for in the above tables, being excesses above full tens.

the food which he saw in the center. This, along with his trials and accidents, accounts for his getting as far as to *n*. After

this mere accident, apparently no curiosity, along with what seemed to be a feeling of disgust at having failed to procure the food induced him to make his way through the remainder of the maze. In the earlier trips the sight of the food was the leading stimulus. But it played a smaller role in proportion as the maze was learned. Once when free in the room the monkey entered the maze and made the trip as if in the hope of food as a result of the process though no food was in sight at any time. Evidently the food is imagined as a final outcome of the trip. The smacking of the lips when some distance from the food and headed in the opposite direction would seem to warrant this conclusion.

A cat was taken through the maze 6 times. *Taken through* is literally correct. The cat cared as much for me as for the food, so after some time I sat down in the center of the maze. But the cat after two hours, having slept 20 minutes in the meantime, had only gotten in next to the center, and appeared to be absolutely incapable of further progress. I then moved over to *p*. In a few minutes the cat was going back and forth near me, but would make no further progress. I moved on to *v*. It followed, paced back and forth and lay down to sleep again. When I moved on to *o* it followed, and presently made the last three feet unaided. In subsequent trials it learned to go the last 12 feet alone, but had to be coaxed as before over the journey up to that point. The cat was less at home in the maze than the monkeys were. It tried to claw the wires apart and to squeeze over the tops of the frames to which the wires were fastened. In its movements it was slow and stupid as compared with the monkeys. It apparently profited less by its experience at the last part of the maze. But its liking for persons was so much greater than theirs that it was somewhat put to disadvantage by my presence.

No other animals were put through the maze for similar comparative studies. It may be of interest, however, to compare the time for the monkeys and one of Dr. Small's rats, although the sizes of the two mazes differ so greatly. The upper line gives the time for the rat for ten trips. The other two lines give the times for the monkeys. All are given in seconds.

780	180	240	105	60	90	180	30	60	120
2700	1800	420	180	900	230	390	285	160	204
3300	7920	840	420	375	450	210	195	165	135

In order to compare the rates of improvement the above numbers have been converted into per cents, regarding the first numbers consecutively as 100 per cent. and computing the per cents for the succeeding times. Arranged in the same order as above they appear as follows:

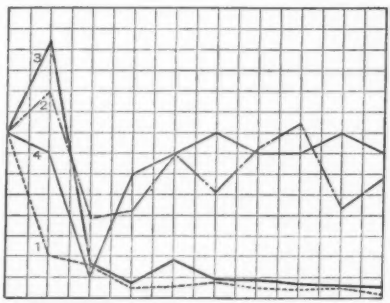
100	23	30.8	13.5	7.7	11.5	23	3.8	7.7	15.4
100	66.7	15.5	6.7	33.3	8.5	14.4	10.5	5.9	7.5
100	240	25.5	12.7	11.4	13.6	6.3	5.9	5	4.1

While the times for the monkeys are much greater than for the rat, the per cents show the rate of improvement for both to be much the same. The longer time may be due to the fact that the maze was much larger. The variations with the monkeys are much greater than with the rat, and the initial improvement is greater with the rat possibly because Dr. Small allowed it to go at will through the maze during one whole night following each experiment. This experience in the maze apparently should have tended to equalize the rat's subsequent trials, since the greatest variations in time and errors occur while the animal is becoming acquainted with the maze.

Comparison of Results.

Inasmuch as I have now presented all of my experimental studies except the memory tests it will be of interest to make a comparison of the rates of mastering the several kinds of apparatus. Accordingly I have made out two sets of curves, one based on the first ten trials, and the other on the tests necessary for establishing a fairly complete association.

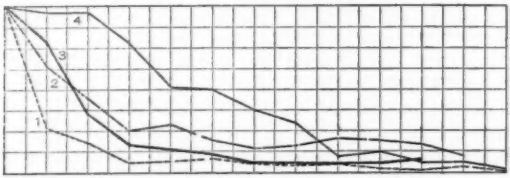
Curves based on the first ten trials. Curve (1) represents



the progress of the first ten trials with the seventeen fastenings and other simple apparatus shown in a preceding section. The time for working the apparatus the first time was taken as 100 per cent., and the nine succeeding times were converted into per cents of this first time. The order of the consecutive trials is indicated by the alternate dividing points along the abscissa. Curve (2) is based on similar computations with the times for the first ten trials with the combination locks. Similarly, Curve (3) is based on the first ten

trips through the maze. Curve (4) is based on the errors committed on the first ten presentations in the tests in colors, forms, and numbers. Twenty-two groups of ten tests were used. The simple fastenings and the maze, curves (1) and (2), after the second trip, are very similar. Curves (2) and (4), (combination locks and colors, etc.), for the first ten tests are very irregular, but strangely enough happen to run along somewhat together.

Curves of Learning. These curves represent the complete learning process. Curve (1), as in the previous set of curves,



is based on seventeen locks, etc., these locks were practically learned in 13 trials. Curve (2) is based on the times of the monkeys with combination lock 1, which was learned by them, and on the first 120 tests with the male with combination lock 2. This was included in the calculation because he had practically learned the combination at that point. These tests were divided into consecutive groups of ten each and the per cents computed as before. In this and the two succeeding curves the consecutive groups are indicated by the alternate dividing lines along the abscissa. Curve (3) is based similarly on the time required for learning the maze. Curve (4) was obtained by dividing the tests for 12 of the forms, sizes and numbers into consecutive groups of ten each counting errors and then computing the per cents as before. In this were used only those series where the association was fairly well established within the 130 tests. Each point then in curve (4) is based on 120 tests and must be regarded as fairly reliable. The similarity of the first, second and third curves is very striking. The elevation of (4), especially at its second and third points, over that of the other curves is probably due to the fact that in a large per cent. of these tests there was first an old and conflicting association to be broken up before the new one could be begun. Progress in the new association would not set in until after 30 tests had been made. Beyond that point the curve is not very unlike the others, however; it shows the same gradual improvement in the associations. While the first few tests with different kinds of apparatus show very different results, as may be seen in the first set of curves, the curves of learning by trial

are rather uniform. Clearly then the first ten or twelve tests cannot be regarded as showing the curve of learning since the results with these vary considerable, not only with the animals but also with the apparatus used. A far better notion of the progress of learning is to be gotten from curves representing results from the first tests to comparative mastery.

The maze, it seems to me, offers no new problem above that of working a combination lock or associating food with one of a series of glasses by number, form or color. The number of trials required for attaining comparative mastery is much the same for each. In the learning process we have here again a more or less definitely directed effort spurred by the food stimulus, fortunate accidents, memory of them and the elimination of useless efforts. Thus blind alleys are cut off, return movements are omitted, the shaking of the maze is dropped, as the path and method of getting the food gradually become fixed upon the monkey's mind. The maze tests, therefore, throw no new light on the general problem of the monkeys' intelligence or method of learning. They confirm the results of the preceding tests, however, and in a general way make an interesting point of connection with Dr. Small's admirable work on rats.

MEMORY.

Memory tests were made three times with the male and twice with the female. The tests were made at regular intervals of fifty days each. The combination locks and maze were used. Each monkey was given ten trials with each apparatus. Probably a comparison of the times for manipulating the locks and going through the maze with the original learning times will give the best notion of the results. The errors run almost parallel with the times, and so, need not be presented.

The first series of memory tests, show reactions shorter than the first ten trials of the original learning, but longer than the last ten trials. The average time required for manipulating each piece of apparatus for the first memory series was about equal to that of the ten trials at the end of the first third of the original learning series. But when the male was taken through these tests after a second space of fifty days he showed a decidedly greater loss than he had shown at the end of the first period, as is to be seen in the table. The female in her second series of memory tests showed a decided improvement, not only in the time required but in her manner of attack, especially in the maze. There she acted precisely as if she knew quite well just how to go through. She made but few errors, and none at all in the last half of the maze. The male, however, by his hesitations, return movements and entrance into the blind al-

	Apparatus.	Average Time for Learning. (In seconds.) First Ten Tests	Last Ten Tests	Tests with time nearly equal to memory time	Average Time for Memory Tests. (In Seconds.) First Series	Second Series	Third Series
Male.	1st Combination Lock.	34.0	6.4	4th ten 14.4	13.7	22.7	15.6
	2nd Combination Lock.	105.3	13.6	6th ten 27.0	28.1	44.3	66.2
	Maze.	726.9	59.5	2nd ten 73.7	88.3	110.6	157.1
Female.	1st Combination Lock.	89.8	5.1	5th ten 16.2	14.2	10.8	
	2nd Combination Lock.	101.1	19.6	5th ten 32.5	31.0	17.9	
	Maze.	2579.0	55.0	2nd ten 127.7	120.0	44.5	

leys, showed unmistakable signs of confusion, which in his third memory series was still more apparent. In this series he moved less rapidly than in his previous tests, while the female showed herself unusually enthusiastic and increased her originally slow gait considerably, so that while she had formerly required 45 seconds as her minimum time for passing through the maze, she now did it in two separate trials in 31 seconds each. He formerly went through in 39 seconds, but now required 84.

In his third and her second memory series they had been without food the same length of time, and were practically equally hungry. Yet one showed some loss and the other considerable gains over the preceding memory tests and even over the best results in the original learning. It is impossible to say that the monkeys have been equally hungry in all of the tests reported in this paper. Probably they have not been, though every care was taken to have them so. Again, practically nothing is known of just how progressive hunger affects the mental capabilities of animals. All absolute time and error results may have been partly determined, however, by this varying factor of hunger.

In none of these cases is the memory perfect; that is to say, the animal's execution of these tasks was not as good as on the last trials in the original series. Usually the first memory trial

took a comparatively long time and resulted in a large number of errors, but the one trial apparently revived the former images so well that the second trial compares favorably with trials after considerable practice in the original series. This memory, probably, is of the type commonly designated as *associative memory* and does not differ in its essential character from the associative act involved when the manipulation of a piece of apparatus was first being learned. In all such cases the sight of A lead to the expectation of B. If B was imaged, it was done immediately after the presentation of A to the senses. It is possible that B was never recalled between tests however far they may have been separated; it did not recur until the immediate preceding presentation was at hand. In the darkness of his cell the monkey *may* recall in trains of images how objects look, recall something that he did on the preceding day, or may image the special dainty dish on which he dined yesterday or a week ago, but if he does, the fact of such a process can never be known until he learns to introspect and can be taught to write or speak, and that can never be done.

Memory tests with simple apparatus can have but very little value if experimenting has gone on in similar lines between the times of the original and memory tests. It was shown in our tests with simple locks that the horizontal hook which had not been learned at first was worked very quickly several days later, simply because there had been some general improvement in the meantime in dealing with that modality of apparatus. With such apparatus, if experimenting has intervened, an animal might appear to remember very accurately over an interval of fifty days, when in reality his success was due to general improvement rather than to excellence of memory. When there has been no intervening experimenting of any kind it appears that we ought to get better data in case of the animal than we could get with a human subject. It is probable that the animal never recalls the experiment or the apparatus from the time of the original experiment until the memory test is made. With the human being it is quite impossible to avoid the intermediary recalls so that in such cases we do not get a test of the pure permanence of an association based upon a given number of trials in so perfect a form as we get it with the animal. Unfortunately we have as yet no memory tests with animals similar to these reported here, so far as I know, with which to compare them in determining the relative excellence of the monkey's memory.[1]

[1]One of the best experimental studies of the human memory yet made is that by Ebbinghaus Ueber das Gedächtnis, Leipzig, 1885. Summaries appear in James's Psychol., Vol. I, p. 676, and in the *Amer. Jour. of Psy.*, Vol. II, pp. 587-603. Ebbinghaus found that after a month

Smell.

It was early suggested to me that the monkeys might be making their choices not through perception of color, shade, size or form, but through the sense of smell. Neurologically they would be expected to possess no such keenness of smell as the suggestion implies. Their olfactory lobes are said to show but very slightly greater development than those of the human subject, and certainly the human being under similar circumstances would have great difficulty in making such selections by means of the sense of smell.[1] Many indirect evidences have arisen which seem to indicate no such keenness. The male when offered some rice mixed with castor oil, took a handful of it, smelled of it at very close range and then threw it aside and wiped his hands. Here smell was a final test, but one made at very close range. When using two rectangular boxes, alike in every respect except that above the back side of one of them, a cardboard extended upward about three inches and bore various devices and was cut into different forms, although several hundred tests were made, food always being put in the same box, the male divided honors about equally between the two boxes. If in other cases where he was successful in making the distinctions, as with the forms and colors, he was dependent upon the sense of smell, then with these boxes he should also have been successful, for the stimulus in that event was the same here as in those cases. But if he was dependent upon the sense of sight, the distinguishing marks for the vessels being unlike in the two cases, the inference is natural that the monkeys simply failed to notice the designs and markings. Again when the feeding forms were glasses covered with colored papers, often when ten feet away from the board on which they stood, the monkey could be seen to give a quick glance along the board and then to make a bee line for the glass containing the food,—a type of behavior hardly capable of explanation on an olfactory basis. In some tests where the glasses were arranged in the order 1, 2, 3, 4, 5, 6, the monkey went to three, then looked into 4, 5, 6, 4, 3, and 2. The food was in 2, and 1 had just been used as the food glass 180 times, while the other glasses had never contained food. If the sense

the same series of nonsense syllables could be relearned in four-fifths of the time originally required. The tests with the monkeys are not exactly comparable, but judging from what they did recall in ten tests I should infer that they would have relearned the maze after a period of fifty days in about one-third of the time originally required.

[1] The cases of Julia Brace, of the American School for the Blind, at Hartford, and others are exceptional, and are to be regarded as hypersensitiveness. Miss Brace is said to have been able to distribute the wash of the institution simply by the sense of smell.

of smell was the basis of choice this movement away from the food should not have continued all the way up to 6, and the glasses should not have been *looked* into with so great care.

When making the tests for discrimination of grays (second control test in the section on color discriminating) with the two glasses, both glasses had been used hundreds of times for feeding, yet where the shades were very different the monkey chose correctly almost every time. If he had been dependent upon odor for his choice he should have discriminated between glasses widely different no better than between those differing but very little in shade. But we have seen that choosing improved regularly as the difference between the shades was increased. In the experiments with designs where the shaded glasses were finally substituted for the designs the glass colored black had had food in it only a few times, yet the monkey sometimes chose black even though the food was in the lighter from which he had been fed many times, and my hand containing some food was nearer the food glass. Again in all the experiments with glasses and bottles the male only once put his nose to the neck of a bottle as if to smell for the food, and that may have been only an accidental position and no real effort to smell out the location of the food. The female never appealed in this way to the sense of smell.

These inferences and the general impression left upon the observer, both enforce the conclusion that the sense of smell was by no means acute in these animals, and that they relied in all of their choices to a vastly preponderating degree, if not exclusively, upon the sense of sight.

Individual Differences.

The individual differences between the two monkeys are very great. Many of them have been pointed out from time to time in former sections, and it only remains to draw them all together here.

The female is the older by some four or five months. She is larger and covered with more and longer hair. This is especially true of the face and brows, and gives her a more repulsive visage. The eyes and nose vary according to age as they do in the human family. With the young the bridge of the nose is low and broad and the eyes seem to stand far apart, but with the adult the nose becomes more prominent and the eyes seem to lie proportionally closer together. I received the female one month later than the male. This has made her appear at times less like the male than she really is: her earlier reactions to the laboratory environment being set side by side with his later ones. Dated notes along with tabular results, however, served to control this tendency.

The male is more timid than the female. I attribute it to the fact that he is less rugged than she. He has been ill twice, but has managed to regain his health. When ill he was unusually nervous. Owing to his nervousness he reacts quicker to any sudden noise, and "flies to pieces" before he has time to see the cause of the disturbance. When I approach the cage in which they are kept the female sits on the perch nearer the front of the cage. The male sits behind her or springs wildly about the back part of the cage. When out in the room together she will approach nearer than the male, and is bolder in her efforts to snatch food. The male is swifter in his movements than the female. When I desire to separate them I have only to open the door of the cage. He rushes out and there is plenty of time to close the door before she reaches it. When moving about the room from table to window, from window to sink and back to the large case or to the cage he is nearly always in the lead. When they climb a tree together he is in the lead both in going up and coming down. She does not run but shambles off in an awkward sidewise manner.

The interest shown in each other is worthy of mention. The male more frequently makes the request to be picked. If the female is put into the cage and taken out into the hallway he is much concerned and climbs the gas pipes and springs to the transom to see if she is near. Then he gives the call, in fact, repeats it often. He looks frightened and stops frequently to listen for her. But if *he* is taken out she settles down deliberately to business and shows no disturbance at his absence except occasionally to answer his calls.

In the earlier experiences she was the head of the family. But she exercised this family presidency on but few occasions, once with a significant stroke more vigorous than a caress, which, however, missed the mark, and again in a scramble for a vantage point in which he was worsted.

Since publishing the first part of this paper in which it was stated that the female was master, the male has begun to assert his rights. He now allows her to sit in front and reach for food, but then takes it from her, and pushes her off the perch. She makes no effort to regain the food, but patiently sits below and eats what he lets fall.

If several pieces of bread are tossed into the cage the male seizes one or two and proceeds to fill his cheek pouches. The female takes one in each hand and pulls others up near her as her own. I have seen her with one or two pieces near her and at the same time with a piece in each foot and a piece in each hand and another in her mouth. Her greed far surpasses his. She is more filthy in her habits than he, very frequently lapping her urine and even eating her excrement. He rarely

has done the former, and never the latter, though he certainly was as hungry as she. But neither has any idea or spirit of cleanliness.

In their reaction to the locks the male moved more rapidly about the boxes. He tried more persistently, and gave up only after many fruitless efforts. Thus on the horizontal hook he was less discouraged at the end of 17 minutes of trials than she at the end of 100 seconds. She required to be helped by having food placed on the parts to be moved, and did not at last substitute a better method of turning the lock after it had been learned. The male sometimes opened a lock a few times with his teeth and then substituted the hand. If the lock was tried with the hand and that failed the teeth were applied. He would try to work a fastening by moving it; she tried to chew it up or to break the strings with her teeth. She always seemed stupid in beginning, but often came suddenly to the idea, and finally, if it was an easy thing, learned it more quickly than he. Thus the first combination lock was learned by her in 80 trials, while the male required 253, but the amount of time required for the first manipulation, generally, is decidedly in favor of the male. With the second and more difficult combination lock she is far his inferior as the tables show. In all of the very difficult things he appeared to be superior, but for the easy things she was superior.

If we turn to the association with forms the reactions are very much alike. When the forms were set down the male sometimes rushed up quickly looking behind him, both right and left, as if frightened. He seemed scarcely to give more than a furtive glance at the forms. But the female shambled up in a slow wabble going straight to the point for which she started. After a series of experiments with the male, if there was perfect quiet, he became more composed and settled down strictly to business, but his nervousness and swiftness of movement will in part account for his greater irregularity after a thing was fairly well learned. Little noises sometimes veered him to right or left from his objective point. With the size boxes both showed a tendency to select larger rather than smaller boxes.

The female learned colors more readily than the male. For the most part this appeared to be due either to a clearer color perception or to greater associative capacity, but in part also to the fact that she approached more slowly, thus giving herself time to survey the line of glasses more carefully, while the male at times was so anxious and quick of movement that he rather took what he ran against. When he was inclined to do this I would hold the board until I saw him glance along it and then set it down.

When making these experiments it was necessary to take a minute to rearrange the glasses and put the food in. In the meantime the male would sit near by flea hunting or with his hands crossed, waiting for his next morsel. The female, however, would run to a distance and sit down. On coming again to the board she would walk or slowly shamble up, killing a great deal of time. Or, perchance, she would climb into one of the oak trees and get a dry leaf to eat. If the board were set down just as she got the leaf she would usually munch the whole of it before starting for the food in the glass. Sometimes, however, she carried the leaf with her.

As to color preference it has been shown that the male preferred yellow, orange and green, while the female fell to taking the food in regular order, and thus defeated the purpose of the experiment. When put into the box with colored illumination the male tried to escape, but the female spent her time in sitting about apparently in inquiry and wonder.

The individual differences in reaction to the number tests have been quite fully set forth in the section on number. In sum, it may be said that with the lower numbers she made the association more readily than he, but that he continued the associations up to six, while she stopped with three. In the reactions to the maze she required longer times at first and never went through in so short a time as he did, except in her second memory test, but she learned the maze with only about half as many trials as he required. The individual differences are apparently as great as they might be expected to be in two human beings selected at random. The assumption of some anthropologists that the lower animals of a given class react in practically the same way to the same environment can only hold with animals of this grade in the most general sense.

IMITATION.

In this section I want briefly to set forth what seems to me a reasonable conception of imitation and to bring forward the cases observed, to be evaluated according to the criteria presented, and this the more, because Dr. Thorndike, in experimenting with his monkeys, found no cases of imitation. If one declares, even after any amount of careful observation and experimentation, *without definition*, that an animal does not imitate, does not generalize, or does not reason, his declaration has on that account but little value. Again, if he defines these terms only in their highest forms of human activity, and then declares that the animal has not attained to them, his declaration has a certain value, but it gives only a limited view of the animal's activity. It merely states what the animal does not do. It amounts to a mere negation and nothing more. The pro-

cesses of imitation, generalization and reasoning, about which there is so much contention in animal psychology, all manifest themselves in the human being in more than one form. There are higher and lower forms. It is reasonable to suppose that animals will not present the highest forms, but that some of them will at least show something of the lower and preliminary forms. Such indeed is the necessary assumption, if we are to believe that the human mind is derived in unbroken series by increasing complication of factors found in the simplest animal reactions. Let us examine some of the classifications of imitative reactions.

Lloyd Morgan[1] classifies the imitative activities as instinctive and intelligent. Below these he places mimicry. On the latter point he says:[2] "Passing reference may here be made to those instinctive actions for which *mimicry* is now a recognized biological term. Certain distasteful butterflies, for example, are mimicked by others, which are believed to have escaped destruction because of their mimetic resemblance to the others. There is no intentional imitation. The mimicry is purely of objective significance. And not only in form, but also in their instinctive behavior, are many of these insects, and perhaps some birds, mimetic of others. Such behavior is, from the purely objective point of view, imitative. But since there does not seem to be any good ground for supposing that the mimetic behavior is called forth by the stimulus of such behavior in the models, it does not fall under the head of instinctive imitation we are considering. By using the term 'mimetic' in its biological signification, we may mark off these cases in mimicry in behavior from true examples of instinctive imitation—that is to say, instinctive behavior called forth by similar behavior in others."

By *instinctive imitation* is to be understood "the congenitally automatic behavior, which from the observer's standpoint, is imitative." "It is an organic response independent of experience." This phase appears to be identical with Baldwin's organic imitation.[3] In such cases there stands an instinct ready to be called into action by its appropriate stimulus. The newly hatched chick will give a warning signal at the sight of some threatening object. His action is purely instinctive. Another chick, not seeing the object, will take up the refrain and will repeat the signal. Thus, though the usual or perhaps appropriate stimulus for setting off that instinctive action, with the second chick, is wanting it takes the warning

[1] Habit and Instinct, p. 174.
[2] Habit and Instinct, p. 169.
[3] Mental Development, p. 263.

signal of the other chick as its cue. Hence, from the observer's point of view, chick No. 2 imitates chick No. 1, but in reality his behavior was only an automatic response. For further illustrations of this phase of imitation see Lloyd Morgan's Habit and Instinct, p. 166. Apparently the instance presented by Dr. Thorndike, Animal Intelligence, p. 48, can be explained in this way. The first members of a flock of sheep, as they were driven along, were compelled to jump over a hurdle. Then the hurdle was removed, but several sheep immediately following sprang up as if to clear the bar. The sight of the leap in one, induced reflexively, similar action in the one succeeding. Objectively it looks like imitation, but subjectively it is automatic behavior.

True imitation implies an action or a result to be copied, and a certain amount of preliminary experience, is due to conscious guidance, and is based upon the immediate satisfaction which accompanies the act of imitation itself. When a child is to trace a curve the "preliminary experience" consists in the previously "acquired data in the light of which control over his arm and finger movements may be exercised." "In the case of the curve, the child first imitates the action—holds the pencil and moves the fingers in certain definite ways. But as soon as passable results are reached, it is on this, and not on the movements, that he fixes his attention. His object is no longer to imitate the action, so much as to reproduce the copy."

Again, imitations have been classed as simple and persistent.[1] "By *simple imitations*, reactions are characterized, in which the movement does not really imitate, but is the best the child can do. He does not try to improve, by making a second attempt." By *persistent imitation* is meant the child's effort, by repetition, to improve his imitations.

In a word then we have:—

1. *Mimicry*, which lies below the level of imitation.
2. *Instinctive imitation*, or automatic behavior.
3. Intelligent imitation.
   a. Of actions.
   b. Of results.

Two special forms have been described:—

(1) *Simple*, consisting of single efforts, but with no succeeding attempts with a view to improvement.

(2) *Persistent*, consisting of several attempts at improvement.

If I am asked whether these two monkeys have imitated, the answer must be divided. Corresponding to the *mimicry*, described above, we have the instinctive crouching, simulating

[1] Baldwin's Mental Development, p. 132.

the crouching of the feline tribes of animals. (See General Observations.) So far as these animals are concerned they spring upon nothing. The crouching simulates the action of an animal which does crouch and spring. But the crouching is used by these only as a bluff, and certainly with no notion of imitating those animals or its fellows. And indeed it does appear threatening, but a wave of the hand or a square look into his face changes bravery into precipitate flight. I am not informed as to whether the adult *rhesus* ever crouches and actually springs upon his prey, but these young ones have shown no sign of doing so.

Instinctive imitation, or automatic behavior, was observed frequently when the monkeys were in separate cages. When one could not see the other, if either gave the danger signal, or the food signal, the other immediately repeated it. The similarity to the action of the chicks described by Morgan is so close that no further discussion is necessary.

Again, of the simple form as discussed by Baldwin, I observed one very clear case. The male looked under the bottom of one of the trees that stood in the room. This required that he should put his face clear down onto the floor. Immediately afterwards the female took a peep in exactly the same way. She did this but once. This appears to me to come clearly under Morgan's class of intelligent imitation of an act. Of course the female did not set out deliberately to repeat the act simply for the sake of the act. But seeing that he did thus and so she voluntarily and not reflexively repeated the act to satisfy her curiosity or in the hope of getting food, though the male had gotten no food as a reward for his act. There were many other cases of this type, as it seems to me, though they are more difficult to demonstrate. The difficulty arises out of the fact that the actions may have complex motives. As, for example, if the male springs upon the table or into a window, or climbs a tree, the female follows suit. Does she imitate his act? Possibly she does. Possibly she is actuated by the same motives as he, and being the slower of movement is a little behind him. This gives her the appearance of imitating. My belief is that having once clearly demonstrated that she could imitate, we are safe when evaluating such cases as the above in assuming that she responds to a complex motive of which imitation is probably a part. Some of the other motives are fright, feeding and flight, and the social instincts.

But again I have observed two cases of imitation of the *persistent* and *intelligent* types. These have already been described at length. (See Simple Locks, Methods of Learning.) Here we have a copy in the form of an act. It was copied almost in detail, and that, too, so far as the place of laying

hold of the plug and the direction of the pull were concerned, both requiring very radical changes from the monkeys' own previous efforts. Further, the copy was repeatedly followed and fashioned into a well-defined habit.

Then, have the monkeys imitated? Neither have imitated any of my acts so far as I am aware. The male has rarely ever done anything that could be regarded as an imitation of the actions of the female. The female, however, has imitated the male, manifesting every phase of the process as defined above.

General Notions.

I can do no better here than to follow the general plan of the preceding section.

Romanes[1] used the word *Idea* as a generic term to signify, "indifferently, any product of imagination, from the mere memory of a sensuous impression up to the result of the most abstruse generalization."

"By *Simple Idea*, *Particular Idea* or *Concrete Idea*, I understand the mere memory of a particular sensuous perception.

"By *Compound Idea*, *Complex Idea*, or *Mixed Idea*, I understand the combination of simple, particular, or concrete ideas into that kind of composite idea which is possible without the aid of language. [Called by Romanes a recept.]

"Lastly, by *General Idea*, *Abstract Idea*, *Concept*, or *Notion*, I understand that kind of composite idea which is rendered possible only by the aid of language, or by the process of naming abstractions as abstractions."

One may not be inclined to accept the name here applied by Romanes, yet psychologists accept some such phenomena in mental life as the basis of naming. (Ribot and James.) The particular images, or ideas, are of the nature of mental images, or memories of such and such objects, as the sound of a voice or the image of a particular horse. If there is such a thing as a general idea, it must arise out of particular ideas, as when we get the general idea, horse, from observing numerous horses. His second and third classes above would include general ideas. The third class (barring discussion of the problems of nominalism, idealism, and the notion of the "rule" or "schema" as designated by the general terms of language) represents the higher human generalizations.

Ribot names three classes of general notions above and beyond the pure individual representations, the first named by Romanes.

1. *Abstraction and generalization* with no possible aid from

[1] Mental Evolution in Man, 1899, p. 34.

language. These are called *generic images* by Huxley, Galton and Ribot. They are the same as Romanes's "recepts," and are intermediate between the pure image on one hand the generalizations on the other.[1]

2. *Intermediate abstraction.* These imply the use of words. "At their lowest stage they can hardly rise above the level of the generic image; they can be reduced to a vague schema, in which the word is almost a superfluous accompaniment. At a stage higher the parts are inverted; the representative schema becomes more and more impoverished, and is obliterated by the word, which rises in consciousness to the first rank."

3. *Higher Concepts.* These can no longer be imaged. This is the characteristically human form where everything is subordinated to language.[2]

In brief form we have then:

1. Individual representations, concrete ideas, pure images. This class is offered not as a kind of generic image, but as lying just below the level of generic images, and yet closely allied to them.

2. Generic images, or recepts, compound idea, complex idea, mixed idea, abstraction and generalization with no possible aid from language.

3. Intermediate abstraction.

4. Higher concepts, general idea, abstract idea, concept, notion.

Accepting the above classification we are ready to ask whether the monkeys have given any unmistakable signs of having any of these classes of ideas.

It may be doubtful whether the monkeys have "free ideas," that is whether they do call up the image of anything not now present to the senses. Do their minds as they sit quietly on their perch play with images and scenes from other times and places? It is probably impossible to know that they either do or do not have such images. Those committed to the law of parsimony, can say in truth, that it is possible at least to reduce all seeming manifestations of such free images to lower terms; while those not so committed can say with equal justice that the same may be said of human behavior also, and with the monkeys we observe such objective phenomena as in the human being are the regular accompaniments of free ideas. Such acts as the efforts to enter the box for food, smacking the lips while passing through the maze, climbing the gas pipes and springing to the transom to see the mate that had been caged and removed to the hall, and other similar acts are, to say the

[1] See, also, James, Vol. II, p. 46-48.
[2] Evolution of General Ideas, pp. 10 and 88.

least, very like what human beings do when calling up images of objects and persons not present to the senses. These are fairly good signs of our first class, particular images.

As to the generic images not requiring the use of language it seems to me that three very favorable cases have arisen, two of which bear some of the ear-marks of the still higher form regarded by Ribot as *intermediate abstraction*. The first case is that presented in the third section of Methods of Learning. It seems to me that the only reasonable way to explain how the monkey came at last to single out and attack a fastener at a new place on the door, immediately on coming up to it, while in the earlier tests he tried almost anywhere, is to say that he developed some sort of a general notion of a localized hindrance. The fact of projection above the surface of the box would appear to be the only general quality of these fasteners, though the plugs and levers had more in common than all the other fasteners had, such as being made of wood, projecting rather far, having a rigid appearance, etc. It seems quite probable at least that some such notion arose and served as a starting point in singling out from the total complex of a box with door, holes, edges, lights and shadows the objective point for attack. No control tests were made, however, to verify such a general notion in this case.

The case described under the second control test in discrimination of color and shade seems to be a fairly good one and represents a tolerably high degree of abstraction. The generic image, if such it was, was that of a darker and a lighter glass with food in the lighter. This image was then modified to fit the new conditions whatever they might be. There was one clear alternative, namely: the monkey's æsthetic taste, or an instinctive feeding preference for lighter over darker forms, may have been so strong as to draw him always to the lighter forms. But the tests with designs, where the food was put into the darker glass, contradict such a supposition. I undertook by the same method as that employed in the tests with designs to change the male's feeding habit to the darker glass. But the old habit established by 3,200 tests proved to be so strong that it would have required several hundred tests to change it. So I used the female. Four hundred tests were made with her, feeding in the darker glass. These sufficed to show clearly that she would establish as strong a feeding habit, if not a stronger, with the darker as the male did with the lighter form.

Still a third case was noticed, and is reported under the fourth control test on discriminations of color and shade. Referring to the tables there we see that when the blue glass with its three corresponding grays was presented, the male in the first thirty chose correctly 17 times, and the female 13 times. When

the yellow was next presented with its grays the correct choices in the first thirty tests were 12 for the male and 27 for the female. With the red the figures are, 26 for the male, 24 for the female. When the green was reached the corresponding numbers rose to 28 and 30 respectively. This difference becomes more striking if we compare the first ten tests of each color instead of the first thirty, since it shows better how abruptly the correct choosing came in. The correct choices in the first ten tests of the male, for the blue, yellow, red and green respectively were, 2, 2, 8 and 8; the female's were, 5, 8, 8 and 10. Why this improvement as we change from one color to another? Is it because the green and its grays are distinguished better than the blue and its grays? The next table, the tests for which were made some days later, would indicate no such difference in favor of the green. Besides now the blue is chosen out from among its grays, practically as well as is the green from its grays, and the choices of yellow with the male have risen now to an equality with the others.

Then do we have here a general notion to be represented perhaps by "food-always-in-the-odd-glass?" If so we might substitute one red and three blues or a gray of one shade and three grays of another shade and still get from twenty-five to thirty correct choices out of thirty tests. But when this was done they immediately dropped to from three to ten correct choices out of thirty. Clearly, then, this was not the general notion in the mind of the monkey. But suppose we should say that the notion was such as could be represented by the formula "food-in-the-colored-glass." This seems more plausible. The notion has risen from extreme vagueness to almost perfect clearness. Now the reaction to all colored glasses or to all grays as before is all confusion and is just what we might expect from an adult human being if we were to place three blue and one red, or three dark and one light gray glasses in a room and tell him to bring us the colored one. He would look them over several times and then bring all or none.

But there are yet two possible alternatives for avoiding the idea of a general notion here. The monkeys had been fed from colored glasses on this board before; they then would be expected to go to the colored glasses instead of the grays. But they were fed from grays when the six grays were used in the control test, and that came after the feeding from colored glasses. Besides this the male started out in the first of these tests going to the grays five times as often as to the blue though there were only three times as many grays as blues. The female, however, went at once to the blue half as often as to the grays. Clearly that alternative will not explain the readiness for selecting the colored glasses as the ones most liable to contain

food. The other alternative is to say that the colors lay nearer the feeding instinct of the animals than grays or that their æsthetic tastes would draw them to these colors in preference to the grays. But that does not account for the improvement. Something gained in the first and second of the tests (with blue and yellow) must have been carried over to the third and fourth, or else the monkeys would have been under the necessity of building up an association with the green and its grays just the same as with the blue and its grays. What was it that was gotten and carried over? The law of parsimony is a valuable law, but in the face of these facts one can hardly avoid conceding to the monkey something like a generic image, by means of which he was able to carry over to the new situation something of his previous experience. To do less is to shoot below the mark.

No one, unless it be Mr. Garner, and he need hardly be reckoned with as a psychologist, and Romanes, perchance, would ascribe to the monkey any of the more general ideas requiring the use of language.

Then to answer our first question in brief: (1) These monkeys appear to have had individual representations of percepts —that is, *A* being perceived they imaged *B*, though *B* was not then present to their senses. (2) They very probably have generic images. (3) The intermediate abstractions, with merely positions of the body, or calls as their signs, may have been present. (4) Intermediate abstractions and higher concepts, both requiring the use of language, are wholly wanting.

I think it safe to say with Ribot that the faculty of abstracting, from the lowest to the highest degrees, is constantly the same; its development is dependent on that of (general) intelligence and of language; but it exists in embryo even in those primitive operations which are properly concerned with the concrete, *i. e.*, perception and representation. Höffding takes the same view.

Reason.

Have these animals reasoned at all while under observation? No simple answer can be given. As before, the question turns upon what one means by reasoning. I find Commissioner W. T. Harris, describing what he calls the Logic of Sense Perception. DeGarmo has reiterated the same in his Essentials of Method. My recognition that yonder object is a horse implies something like this:—

Minor premise. This object has such and such characteristics.

Major premise. Horses have these characteristics.

Therefore . . . .

The syllogistic *forms* in cases of perception are really entirely wanting. From a psychological point of view they are not to be reckoned with, though *logical analysis* may find such processes implied. Where the process of perception is very slow, recognition, identification and verification, the implied logical forms, may rise very nearly to explicit logical forms. But while such analysis may have pedagogical significance, it has no psychological importance, and the matter is here mentioned only to be excluded. They are at most but cases of *implied reasoning*.

Unconscious or immediate inference ranks next in order. A good description of it is found in James.[1] It occurs "where a present sign suggests an unseen, distant, or future reality. Where the sign and what it suggests are both *concretes which have been coupled together on previous occasions*, the inference is common to both brutes and men, being really nothing more than association by contiguity. A and B, dinner-bell and dinner, have been experienced in immediate succession. Hence A no sooner falls upon the sense than B is anticipated, and steps are taken to meet it. The whole education of our domestic beasts, all the cunning added by age and experience to wild ones, and the greater part of our human knowingness consists in the ability to make a mass of inferences of this simplest sort. Our 'perceptions,' or recognitions of what objects are before us, are inferences of this kind. We feel a patch of color, and we say 'a distant house;' a whiff of odor crosses us, and we say 'a skunk;' a faint sound is heard, and we call it a railroad train. Examples are needless; for such inferences of sensations not presented form the staple and tissue of our perceptive life, and our Chapter XIX was full of them, illusory or veracious. They have been called unconscious inferences. Certainly we are commonly unconscious that we are inferring at all. The sign and signified melt into what seems to us the object of a single pulse of thought. Immediate inferences would be a good name for these simple acts of reasoning requiring but two terms, were it not that formal logic has already appropriated the expression for a more technical use."

Ribot describes what appears to be the same as *immediate inference* under the caption, "Inference from particular to particular," under *Logic of Images*. His other subdivision is "Procedure by analogy."

"1. *Inference from particular to particular.* The bird which finds bread upon the window, one morning, comes back next day at the same hour, finds it again, and continues to come.

[1] James, Vol. II, p. 326.

It is moved by an association of images, plus the state of awaiting, of anticipation as described above.

" 2. *Procedure by analogy*. This (at least in its higher forms in animal intelligence) presupposes mental construction; the aim is definite, and means to attain it are invented. To this type I should refer the cases cited above of ants digging tunnels, forming bridges, etc. The ants are wont to practice these operations in their normal life; their virtue lies in the power of disassociation from their habitual conditions, from their familiar ant-heap, and of adaptation to new and unknown cases."[1]

It seems to me that there should be recognized a phase of reasoning somewhat lower than the preceding, and in a general way very like that described by James as " rational thinking," in that it consists of a train of images, but different in that it is connected immediately with perception and action. To illustrate, one desires to reach a certain point on the side of his house. He stands near by and looks over the situation. He now sees that an attempt to go up over the window would fail. He looks at his step-ladder near by, but that is too short. But he notes that he can get on to a low roof from this ladder, pass along to the right and reach the desired point. Free this process from the immediate presentations and we have James's " rational thinking," which in its more purposive forms becomes the predominant process of the inventor. But so long as it is mainly for purposes of action and consists in thinking of one's self in new attitudes and positions within the perceptual field it may with propriety be designated as *adaptive intelligence*, and is of about the same grade of rationality as analogical reasoning which has not yet reached full consciousness and verbal expression.

James's description of " rational thinking " is brief, and I quote it in full.

" Much of our thinking consists of trains of images one suggested by another, or a sort of spontaneous revery of which it seems likely enough that the higher brutes should be capable. This sort of thinking leads nevertheless to rational conclusions, both practical and theoretical. The links between the terms are either ' contiguity ' or ' similarity,' and with a mixture of both of these things we can hardly be incoherent. As a rule, in this sort of irresponsible thinking, the terms which fall to be coupled together are empirical concretes, not abstractions. A sunset may call up the vessel's deck from which I saw one last summer, the companions of my voyage, my arrival into port, etc.; or it may make me think of solar myths, of Hercules's and Hector's funeral pyres, of Homer and whether he could

[1] Evolution of General Ideas, p. 26.

write, of the Greek alphabet, etc. If habitual contiguities predominate we have a prosaic mind; if rare contiguities, or similarities, have free play, we call the person fanciful, poetic or witty. But the thought as a rule is of matters taken in their entirety. Having been thinking of one, we find later that we are thinking of another, to which we have been lifted along, we hardly know how. If an abstract quality figures in the procession, it arrests our attention but for a moment, and fades into something else, and is never very abstract. Thus, in thinking of the sun-myths, we may have a gleam of admiration at the gracefulness of the primitive human mind, or a moment of disgust at the narrowness of modern interpreters. But, in the main, we think less of qualities than of whole things, real or possible, just as we may experience them.

"The upshot of it may be that we are reminded of some practical duty; we write a letter to a friend abroad, or we take down the lexicon and study our Greek lesson. Our thought is rational, and leads to a rational act, but it can hardly be called reasoning in a strict sense of the term."[1]

Finally there is the more formal type which consists in associating two ideas through the mediation of a third.[2] It is the "substitution of parts and their implications or consequences for wholes."

The pure *logic* of reasoning must, however, be kept distinct from the practical or psychological process. The latter involves, according to James (Vol. II, p. 340), first an act of sagacity in extracting from a total complex presentation some character which is then taken as an equivalent to the entire datum from which it comes, and second an advance from this to certain suggested consequences more obviously seen in it than in the total datum as originally presented.

Enumerating briefly we have:—

1. Implicit reasoning. (Harris.)
2. Inference from particular to particular. (Ribot.) Unconscious or immediate inference. (James.)
3. Adaptive intelligence.
4. Analogy.
5. Rational thinking. (James.)
6. Formal reasoning.

The first is present with these animals quite as much as with human beings. There can be no doubt that the monkeys recognize kinds of food and other objects of familiar classes, and it is as fair to apply logical analysis to this process in them as to like processes in human beings. But this is not, from the stand-

[1] James, *op. cit.*, Vol. I, p. 325.
[2] James, *op. cit.*, Vol. II, p. 330.

point of psychology, in any sense a reasoning process either in men or animals.

Cases of reasoning by immediate inference, as James calls it, are numerous. When they saw the box used in experimenting, and although they had just then seen no food put into it, the sight of the box suggested the idea of food and the box was opened. When in the maze certain parts well on toward the end suggested the food and the lips were smacked. Seeing me the food signals were given. Seeing the sink suggests the idea of water in a pan just out of sight, and the sink is climbed for water. Here we have Ribot's "state of expectation," an anticipation, but it is expectation based on the fact that in a previous experience the present percept was followed by the thing now expected to follow. It is a case in which we have two terms associated, but have the mind occupied less with the memory of the past than with the expectation of the term to follow.

The adaptive intelligence, which is hardly reasoning, was well illustrated on one occasion when I tied a piece of apple to the tip end of a limb of one of the trees. This was a strong, long limb, the last four or five feet of which extended along the ceiling. The monkey's weight on this limb could not bend it down. He watched me as I tied the apple fast. Then he rushed up the tree nearly to the place where it brushed the ceiling. He was baffled, and returned part way down the tree, after which he passed out another limb and looked the field over for a full minute. The position was changed and the field scanned over again. Then he went up the tree to the ceiling, swung himself under the limb and went along it hand-over-hand until the apple could be reached. Here the thinking is that of tracing out a line of conduct, planning a campaign and then executing it. It probably consists in putting in consecutive order, somewhat imperfectly, a series of percepts as a guide to future activity. One might wonder whether he did not in his joints, tendons and hands feel himself making the journey. This looks very much like a capability for analyzing a situation. So does the case already reported where the monkey sprang from the corner of the table to the large post and grabbed a pear as he went. But such a capacity apparently neither Mr. Thorndike nor Mr. Morgan will grant.[1]

Whether their processes rise to the fourth level becomes a more difficult problem. Do these monkeys recognize similarity? Do they, in working the latches for example, have a dim consciousness that this projection is like the one whose pulling gave them food, and then come to feel that pulling this

[1] Nature, July, 1898, p. 249.

ought to do the same thing. This, of course, we cannot positively determine. Earlier in the paper and again in the preceding section it was reported that the monkey in his first tests on locked-boxes attacked no specific part of the box, and later invariably attacked the fastener even though it was of a new form and at a new place. Thus, when the push bar was put into the right side of the box no other fastener had been put on the box near where it was placed, except a plug, for several series of tests preceding. It had been preceded by a string, ring and nail on the front, by a latch at the left and front, and by a string in the rear of the box. But when the box with the new latch was set before him he rushed by the front and attacked the pusher immediately. One of two things, he either recognized the similarity of this pusher to other fasteners though it was similar to the others only in being a projecting thing, and to the plugs, levers and lift-latches in being a wooden projection, and concluded that working it would bring food; or, the pull at that point was a mere reflex from the sight of the projecting latch itself, a sort of acquired tropism by which he was attracted to the latches in general. With the first four fastenings the monkey began and opened each several times by mere accident. It took time to discover the latches themselves. But when the fifth was presented, the door bolt, it was attacked directly and moved in one second. Thereafter, with a single exception, the locks were attacked directly and no energy or time was wasted in trials anywhere else about the box.

I am inclined to think that in such cases as this there is a complex state of mind, involving partly the reflex from the sight of the object, and partly the recognition of similarity, along with the food idea, and possibly several other minor factors.

Morgan and Thorndike both insist that animals cannot reason by analogy. However true this may be of chicks, cats and dogs, I very much doubt whether it is true of *rhesus* monkeys. The ruling out of reasoning by analogy with all lower animals, it seems to me, is often due to a failure to differentiate sufficiently the psychological process of analogical reasoning, resulting in practical activity, from a subsequent logical analysis, accounting for the intelligent act. Of course the animals cannot do the latter. In part their reasoning is like that of the human being. Yesterday a man saw a vine and handled it without evil results. To-day he sees another quite like it, handles it and is poisoned. He does not say "Lo, now, here is this and this likeness, therefore it is safe to handle this vine." He was just dimly conscious of a resemblance. He may not possibly be able to name a single likeness if put to the test. So far in his process he and the monkey have gone along together. But

just here they part company. You ask the man why he handled this poisonous vine. Now he furnishes you a logical analysis, a reasoning by analogy, a subsequent explanation of his conduct, more or less definite according to his powers of observation. He says, "Why the thing looked just like the vine I handled the day before, and I never thought of its poisoning me, or I thought it would not poison me." In other words he gives explicitly what was implied in his previous act. From the standpoint of logic he reasons analogically in a process parallel with the analogy implied in his previous act.

Mr. Morgan makes this distinction very clearly in his Introduction to Comparative Psychology, pp. 279-283. He regards what I have here called the psychological process, as "a sequence of an impression, and an idea in sense-experience without implying either perception or conception," and calls it *intelligent inference* in the field of sense-experience. He, apparently, would regard the process as of a kind with our (2) and (3) above (Inference from particular to particular, and Adaptive intelligence). Further, he would say that the logical process is in no wise implied in the psychological, but only the relations on which the logical is afterwards based. He says, by way of conclusion, that he wishes to use the word "intelligence" for the faculty in virtue of which inferences are suggested in the field of sense-experience, and "reason," where the logical relation is *clearly* perceived. Every one, I presume, would grant at once that most cases of apparant implied analogical reasoning, may be nothing more than association, immediate inference or adaptive intelligence; but my position is that some cases, such as that of the latches, where the "prophetic" phase is present quite prominently, may come under Mr. Morgan's implied category of *less clearly perceived*, and yet be reasoning by analogy. The real question is, of course, that of fixing the degree of "clearness" required for analogical reasoning. As a matter of fact the lower forms pass into the higher by imperceptible gradations not to be fixed by hard and fast definitions.

All of the lower forms of reasoning, and forms of activity antecedent to reasoning are usually granted to the lower animals, unless it be that of James's rational thinking, which is hardly to be reckoned as reasoning, but more nearly perhaps as reverie. The field of greatest contention is at the level of analogical reasoning. As to the still higher forms of human reasoning it has often been asserted that animals have employed them, but never, so far as I know, by any psychologist of acknowledged standing.

RÉSUMÉ.

We have seen that these monkeys have indulged in movements signifying emotions such as fright, anger, social feeling, disappointment, curiosity and surprise. The emotional range has been very limited however. There has been no friendly spirit manifested towards the keeper or towards any one else. But the desire for the company of their fellows has been shown frequently by the loud calls when they were separated. There has been no mischievousness nor destructiveness simply for the sake of those activities. Nothing has been destroyed or injured except in attempts to escape and to procure food. The instinctive fear of snakes and cats is present. But frogs and newts merely surprised. There has been no manifestation of play such as springing about the cage or running after each other in sport. The mutual flea-hunt is their only amusement, if indeed it can be called such. Several sounds have been used signifying food, danger, loneliness, anger and disappointment, but these are not words, only very general instinctive responses.

The monkeys have learned to manipulate simple and complex locks and allied apparatus. In doing so they have made a little progress in capability for choosing better methods of working, inhibiting useless acts, and employing short circuiting processes. We have seen how the formation of a third association of three similar but opposing ones resulted in a partial recall of the first, and that it is more difficult to break one association and then form a new, than to form one *de novo*. (See experiments with forms.) We have found several cases of imitation, one being of very high order. We have found evidence, also, of general notions and reasoning, both of a low order. It has been shown that the monkeys associate food with forms more readily than with sizes and colors. In the choosing of sizes they erred in favor of larger forms, whether the sizes were arranged in an arithmetical or geometrical progression. They certainly are able to distinguish colors as colors and not merely as shades of gray. As regards color-preference it can be said at most only that it is probable that they like yellow, orange and green better than red, purple, blue and gray. They were able to do no real counting, but position in a series of objects was recognized by one as far as 3 and by the other as far as 6. Their general intelligence appears to be high, if we compare the time curves determined by Mr. Thorndike with cats, dogs and chicks. Human beings have not greatly surpassed them in some respects when dealing with the apparatus here used. In many of the experiments we have reported the errors made by the animals. It often happens that the errors are more important in the animals' processes than are the time results.

The sort of errors made, the elimination of many unnecessary movements and the character of many other reactions not classified here incline the writer to believe that the monkey's mental processes are after all not so simple as analysts have often asserted them to be. Whether these animals have "free ideas" and general notions beyond the mere 'recept,' and are capable of real analogical reasoning cannot be positively determined. If they do, the processes certainly do not rise to the level of full reflective consciousness. Yet there is no way of knowing, because there is no certain way of having the consciousness that the animal has. But that these monkeys have often acted objectively just as human beings act when they have these mental activities is most certain. I am inclined to believe that the human and animal consciousnesses are not really different in kind but only in degree; the difference in degree, however, is very great.

Appendix.

It is my design to furnish in this section a brief study of the *Macacus rhesus* monkey such as I have been able to extract from the literature of the subject.

The Bhunder or *Macacus rhesus* is the Bandar of the Hindus, and is to be found all over Northern India. It is a very strong looking animal when full grown. The body of the adult is from fifty to sixty-five centimeters long. The tail is about one-third as long as the body. The body is large and thick in front and tapers backward. The limbs and shoulders are very strong. The prevailing color of the hair is olive-green and brown on the back, and a dull white underneath. The face, ears, hands and seat-pads vary with age from a pale flesh-color to a light copper color. With age the face and callosities often become very red.

The whole appearance is so baboon-like that Cuvier,[1] Shaw and Audibert classified them as baboons. In Cassell's Natural History, edited by P. Martin Duncan, New York, 1884, they are classified as dog-shaped monkeys, while Brehm classes them in the same family with the Dril and Mandril, neither of which is ever classed as anything except a baboon. The Royal Natural History, edited by Richard Lydekker, London and New York, 1893-94, Vol. I, p. 113, discusses the Bhunder (*Macacus rhesus*) under the heading, "The Bengal Monkey."

While they are thus classed as one of the lowest of the monkeys or as a good baboon they are invariably regarded as having a high degree of intelligence.

They inhabit a great portion of the inlands of India, and are

[1] The Animal Kingdom, Cuvier, London, 1827. Vol. I, p. 289.

found continuously northward from the valley of the Godaver to the Himalaya, extending to the west coast at Bombay. Great numbers live in the valley of the Ganges, and some are to be met with in the warmer valleys of the Himalayas. They have been seen in the neighborhood of Kasmir at an elevation of 4,000 feet, and near the sanitarium of Simla at an elevation between 8 or 9,000 feet above sea-level. Hutton reports that he saw these monkeys there in February when the snow was from ten to fifteen centimeters deep. They slept at night upon the trees and were apparently oblivious to the cold. They were, however, more stupid than when the weather was warmer. The monkeys were more abundant in winter than in summer in the vicinity of Simla. At times they were seen springing and playing under the pine trees whose boughs were covered with snow.

Near Simla is a hill called Jako. A fakir lives here who regularly calls the monkeys and feeds them. No one has properly done Simla who has not walked or ridden out to see the monkeys fed.

In Bengal the Bhunder lives in great numbers. They like the forests, where they are invariably found. Usually they rove about in great droves. They often go into the plains and cultivated fields, and not unfrequently, even into the towns and cities. Crooke[1] says "The *rhesus* is a most troublesome, mischievous beast, and does enormous mischief to crops, while in cities he is little short of a pest. But his life is protected, by a most effective sanction, and no one dares to injure him." These monkeys are probably never regarded as sacred, though they are protected, and tithes are left in the fields for their benefit. In places they form "part and parcel of the appendages of the temples." There is strong objection to killing these monkeys, probably partly due to the general belief that no one can live where a monkey has been killed. A monkey's bones are exceedingly unlucky.

They delight in the small streams, and are good swimmers and can dive successfully, apparently coming out at the landing previously chosen. When wild these monkeys make a hideous noise with their calling and chattering. They eat large quantities of fruits and seeds, and do a great deal of digging for insects and spiders.

They are docile and easily taught if captured and trained while young, and are much used by fakirs and in shows. They are favorites with trainers for they learn their tricks easily and work at them with great endurance and skill. In captivity, in

[1] Popular Religion and Folk-Lore of Northern India, 1896, Vol. I, p. 88.

their happier moods, they join with their fellows in the "flea-hunt," but are liable to fall out at any time and go on the war path. In youth they may be affectionate toward their fellows and their keepers, but as adults they occasionally like their fellows but always hate human beings. The trainer may make them submissive, but they cannot drive all of the treachery out of them. When they go into a rage they break, tear up or destroy whatever they can lay hands on. If free to do so at such times they will attack a man fearlessly, using their powerful teeth with great skill and force. They are constantly threatening and bluffing at every one who approaches near the cage. They open their mouths, the eyes bat and they set their bodies into a crouching position like that of beasts of prey. Then they whet the teeth, puff out the cheeks and bob part way up as if just starting to spring upon one. Yet unless greatly annoyed they would in reality run away if they had half a chance. Lydekker reports an instance where a gentleman came across a party of these monkeys, among whom were several females with young ones. He undertook to run them down in order to capture one of the young. The old males deliberately charged upon him, and he was compelled to shoot the leader in order to make good his escape.

In captivity they are ill-tempered, jealous, selfish and tyrannical. When males are caged together they are very quarrelsome, so keepers prefer to cage a male and female together.

Lydekker repeats a story from Prof. Bell, who says, "When at Malwa Tal (near the Himalayan Station of Naini Tal), which is one of the lakes where I spent a day, I was warned that, in passing under a landslip which slopes down to the lake, I should be liable to have stones thrown at me by the monkeys. Regarding this as being possibly a traveller's tale, I made a particular point of going to the spot in order to see what could have given rise to it. As I approached the base of the landslip on the north side of the lake, I saw a number of brown monkeys (*M. rhesus*) rush to the sides and across the top of the slip, and presently pieces of loosened stone and shale came tumbling down near where I stood. I fully satisfied myself that this was not merely accidental; for I distinctly saw one monkey industriously, with both forepaws, and with obvious malice of pretense, pushing the loose shingle off a shoulder of rock. I then tried the effect of throwing stones at them, and this made them quite angry, and the number of fragments which they then set rolling was speedily doubled. This, though it does not actually amount to throwing or projecting an object by monkeys as a means of offence, comes very near to the same thing, and makes me think that there may be truth in the stories of their throwing fruit at people from trees."

In some parts of India they are left very much to themselves; so they assemble in troops, and steal from among the natives in a very troublesome manner.

As they are bold, their habits in the wild state are often observable, their slyness and thieving propensities being most amusing. They gather on the roofs of the low houses in the bazaars, and look out for occasion to steal.[1]

In conclusion, I translate from Brehm, p. 134, Cuvier's report of his observations of a mother Bhunder and her baby born in captivity.

"Immediately after birth the young *rhesus* climbed upon the belly of the mother, meanwhile he held firmly to the fur with his four hands, and took the nipple in his mouth, and did not release it for fifteen days. He remained during the entire time in an unchanged position, always engaged in sleeping and sucking. He released one nipple only that he might seize the other. And so he passed the first days of his life making motions only with his lips for sucking and his eyes for seeing. Like all monkeys he was born with his eyes open, and it appeared that from the first moment he could distinguish his environment, for he followed all moving objects with movements of the eyes.

"It cannot be reported, how great the anxiety of the mother was, and how much she was concerned with the sucking and security of her new-born baby. She showed herself often so intelligent and cautious that one wondered at her. The least noise, the gentlest movement eliciting her attention, and anxious care for her young, not for herself; for she had lived with men and had become perfectly tame. All her motions took place with the greatest dexterity, and yet never in such a way that the suckling suffered any. The weight of the young appeared to hinder none of the mother's movements, and made no difference in her activity and bluster. However, it was significant that the mother took double care not to strike her young against anything. After about fourteen days the young began to release himself from his mother and to run about, showing an astonishing strength and dexterity considering that he had had neither previous practice nor experience. The young *rhesus* clambered at once upon the vertical wires of his cage, climbed on them as he would, up and down, took a few steps upon the straw, sprang freely from the top of his cage down onto his four hands and then against the grating onto which he climbed with an agility and security, which would have done honor to the most skillful monkey. The mother followed each movement of her young with the closest attention and appeared always ready

[1] Cassell's Natural History, p. 121.

to prevent any possible injury to him. Later she sought from time to time deliverance from her burden but always showed care for him, and if she thought him in jeopardy she prepared to suffer for him. Also upon the slightest touch of him with her hand the tractable pupil would turn back, and he took quickly the position at the breast of the mother. The springing and playing of the little animal increased with his increase of strength. I have often observed his sports for a long time and with the greatest delight, and can testify that he never made a false move or a wrong estimate of an exact point which he desired to reach. The little monkey gave indisputable proof that, from the very first, he could judge distances correctly and could determine the degree of force necessary to cover them exactly. He knew his natural movements from the first moment, and knew how to accomplish through them certain ends, where human understanding would have required a long series of trials.

"After about six weeks the monkey began to take other food than the mother's milk and new phenomena appeared. The two animals manifested a wide variation in their mental life. The same mother which formerly took tender care of her young, which without interruption bore him hanging to her body and to her breast, and was so full of mother care, was now ready to snatch the food from out his mouth. The same mother did not permit him, as he began to eat, to lay hand upon but the least morsels of food. As soon as the keeper had given them fruit and bread, she seized it, thrust the young from her, if he approached, and hurriedly filled her cheek pouches, before she left it. One greatly erred if he supposed that a nobler impulse than gluttony had moved her to this action. She could not suppose it necessary for suckling the young, for she had no milk any longer, neither did she entertain any apprehension that the food would be of any harm to it. The young ate the food and flourished on it. Hunger soon made him keen, venturesome and active. He no longer shrank back at the strokes of the mother, and now she pushed him away in order to secure everything for herself. The young was cunning and active enough, indeed, to get a bite and to spring around the back of his mother where he devoured it. This foresight was necessary; for the mother many times went to the farthest corner of the room in order to take the food away from her young. In order to prevent injury, which the unnatural feeling might prompt, we gave them more food than the mother could eat or store in her pouches and thus we helped the young one. It continued in good health and was cherished by the mother so long as it did not take her food."

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AN ANALYTIC STUDY OF THE MEMORY IMAGE AND THE PROCESS OF JUDGMENT IN THE DISCRIMINATION OF CLANGS AND TONES. (Concluded.)[1]

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EXPERIMENTAL. CHAPTER II. (*Continued.*)

PART III.

The problems previously considered, viz., the nature and course of the tonal memory image and the nature of the judgment consciousness, are in Part 3 examined by the aid of what may be termed the method of continuous change or the method of reaction. The second tone, V, starts from above or below the standard, N, and moves uniformly toward N until arrested by the observer when subjective equality is reached. The method thus differs from that employed in Parts 1 and 2 for (1) a moving tone is used for V in place of the discrete stimulus of the method right and wrong cases, while (2) the judgment is always that of 'equal' and (3) a movement of reaction is required on the part of the observer.

The method is most similar to that of equivalents[2] with the introduction of a time-interval between N and V. It yields two values, V_o III N and V_u III N, these being the averages of the determinations of subjective equality made in a certain number (in Table VII, six) of movements of V from above and from below N respectively. The mean of these two values, taken algebraically, indicates, by its size and sign, the amount and nature of any tendency on the part of the observer to err in a greater degree upon one side or the other of N. This value

[1] For the first article, see this *Journal*, XII, 1901, 409-457.

[2] Külpe: *Outlines of Psychology*, 1895, 56 f. It may be likened also in some respects to the reaction method as described by Stern (*Psych. d. Veränderungsauffassung*, 108 ff.), who says, "das Characteristische des Reactionsverfahrens besteht darin, dass die Veränderung solange währt, bis die Versuchsperson selbst ihr durch eine Reactionsbewegung ein Ziel setzt." It is hardly necessary to point out that Stern's application of the method was made with a different purpose (the perception of change itself), so that the variable moved more slowly, and not, as in our tests, from a given D toward equality. These points of difference preclude extended comparison of results.

corresponds to the 'true subjective equality' of the method of equivalents proper, but we have chosen to term it the 'estimation value of N.' Finally, the mean of these two values, arithmetically taken, indicates the average distance from N of the upper and lower boundaries of the 'zone of equality.' In a few cases, as the tables show, the signs of the two values of V ||| N are alike; then obviously, the 'average limit of error' coincides with the 'estimation value of N,' and simply determines the center of the 'zone of equality.'

In his use of the reaction method Stern[1] saw fit to subtract a constant value, 0.5 sec., assumed to represent the reaction-time. We have not carried out any subtraction in the present Tables for several reasons.

1. Though the value of the reaction-time is, according to Stern, higher for continuously changing than for discrete stimuli, it decreases as the rate of the variation increases.[2] Since our rate is much faster than any of those employed by Stern, the value in question would be much nearer the simple reaction-time to discrete stimuli than 0.5 second.

2. Stern also includes in the subtracted interval a period known as the 'decision-time.' This is due to an inhibition of reaction, set up by the attempt to secure greater certainty. "Man lässt das Urteil erst eine gewisse Sicherheit gewinnen, ehe man sich zur Bewegung entschliesst; die Anregung zur motorischen Aktion ist bei allmählichen Veränderungen eine sehr geringe." Under the conditions of our own tests, we very much doubt whether this influence is to be reckoned with at all. To be sure we find everywhere evidences of a tendency to premature reaction which is being met by obvious conscious attempts to inhibit it, and this process might seem, on first thought, to be identical with the above-mentioned retardation of the decision. But these are two distinct phenomena. Stern says that the decision-time is "eine, wenn auch *kurze*, so doch nicht ganz zu vernachlässigende Zeit." Under our conditions several tendencies to react may appear and be inhibited before the actual movement, while the interval between each one may be of perhaps one second's duration. It would be manifestly absurd to add these relatively long periods to the observer's reaction-time proper for the purpose of subtraction.

If, however, there should be present a retardation of the reaction of very short duration such as Stern mentions, it seems quite appropriate that this time should be rather included than excluded from the results, for the delay is made for the sake of subjective certainty, and the recorded values will therefore in-

[1] *Zeits. f. Psych.* vii, 1894, 270; xi, 1896, 21; *Veränderungsauffassung*, 109 f.
[2] *Veränderungsauffassung*, 109-110.

dicate simply the point of assured equality rather than the point at which the first intimation of equality appeared.

3. Both the tables and the introspection, as will be more fully shown later, indicate the presence of an uncommonly large error of expectation. This means that the movement of reaction takes place before subjective equality is reached. The method itself offers no satisfactory procedure for counteracting or adequately estimating the force of this error as do those methods in which it is possible to reverse the direction of the steps or movement of V in half the tests. It seems, therefore, unwise to accentuate this error, already so plainly present, by an increment whose amount can be only arbitrarily established.

4. Neglect to discount a value for the reaction-time would affect merely the absolute values of our Tables; the relative values would be practically what they are now; the 'estimation value of N' would be unchanged, save in a few instances.

5. We are not primarily concerned with the quantitative results.

We have, therefore, chosen to present values computed upon the basis of the actual moment of the reaction rather than to manipulate these values by the subtraction of a value whose amount is exceedingly difficult to estimate, and whose influence is perhaps to be questioned in the face of the strong expectation error.

Instrument. For convenient work by this method the following changes in the blown bottle apparatus are advisable if not absolutely requisite.

1. The large air storing tank is replaced by a simple device consisting of two galvanized iron cylinders approximately 75 cm. deep and 30 cm. in diameter. The lower cylinder is filled with water, and provided with a pipe projecting above the water within and connected with the bottle system without; the upper cylinder is inverted and arranged to slide within the lower. A weight of 3.7 kg. on the upper cylinder yields adequate pressure and produces a smoother, less hissing tone than the air stored under greater pressure in the large tank. After 6 or 8 tests, a counterweight of 9 kg. speedily raises the exhausted cylinder, and the experiments can thus proceed with almost no interruption and with far greater economy of energy; indeed, without steam or other mechanically driven pumps, it is very difficult to store enough air for an hour's work by the continuous change method.

2. The smaller crank of the Stern machine is entirely removed. The axle of the larger crank is extended to a length of 130 cm. from the cog wheel, and supported in a rigid journal. The crank itself is replaced by a brass arm 135 cm. long, supplied with a knob-shaped wooden handle. This long crank arm is a necessary help in producing an even revolution of the gearing; the extension of the axle is necessary to permit the lengthened crank to clear the projecting rod of the mercury piston.

3. The armature of a Petzold time-marker is fitted with a light projecting arm of steel, 17 cm. long, carrying two teeth. These parts

are so adjusted that when the observer closes a circuit key, the teeth instantly engage the cogs of the gear wheels so firmly as immediately to stop the movement of the crank by the operator. The advantage of this device over the stop-watch[1] is obvious.

Method of Procedure. One of three standard tones, *a*, *b*, or *c* (corresponding to settings 5, 15, and 25 of the apparatus, and to the pitches 242, 270, and 298 vibs. respectively) is given with a duration of one second, beginning two seconds after the usual 'now.' After an interval (10 or 40 seconds), a second tone, V, is given, which begins 3, 4, or 5 turns of the crank in either direction from the standard setting (*i. e.*, at 8.4, 12.2 or 14.0 vibs. above or below N), and moves uniformly toward the standard, always at the rate of one-half revolution of the crank (1.4 vibs.) per second. When the observer[2] thinks that V is equal to N, he presses the key which, as was above explained, stops the movement of N. The observer dictates his introspection and the operator records the setting of the apparatus in terms of revolutions and hundredths of a revolution, thus giving readings within 0.028 vib. The observer's error is later computed in terms of vibration rate. The observers are *M*, *B*, *S* and *Wh*.[3]

The experiments of Part III are subdivided into four Series, whose conditions are varied in three respects, (1) by using a time interval of 10 or of 40 seconds (2) by procedure with or without *specific* knowledge, and (3) by active attention to, or active inhibition of, the image (artificial distraction).

Series 1.

Series 1 consists of three sets of 18 tests each for each observer at 10 seconds interval. The first set is not figured in the quantitative results because of the rapid growth of special practice which took place at the outset. The third set is taken late in the course of Part III (directly after a series in which the procedure is with knowledge), but is treated in connection with the second, so that Series I, as represented, practically consists of 36 tests for each observer.

In order to make these tests more comparable with those by right and wrong cases, and to avoid the error of expectation so far as possible, the procedure is without knowledge. But this phrase must be used with qualifications. By it is meant that there is no knowledge of the *standard* to be used, of the *amount* of the difference, D, of the *absolute rate* or of the *direction*, of the

[1] Employed by Stern for a similar purpose: *Zeits. f. Psych.*, xi, 1896, 20; xxii, 1899, 2.

[2] In this procedure, naturally, but one observer is tested at a sitting.

[3] Dr. W. C. Bagley kindly served as operator for *Wh* in Part 3.

movement.[1] Any test in which the direction of the movement of V is unrecognized is discarded and a new trial given. The direction of V may be known in two different ways: 1st, by an immediate awareness of its pitch relation to N, 2nd, by observation of V itself as it moves. The second is obviously a slower process, and it is correlated with less accurate judgments. This is to be expected since the slower process implies a loss of the position (tonal or otherwise) of N, and since the very effort of observation entails a distraction of the attention from the real object of the test.

TABLE VII.

All Values in Vibrations.

Obs.	D	V_o III N	m. v.	V_u III N	m. v.	Aver. Limit of Error.	Estimation Value of N.
M	8.4	0.39	1.23	—1.07	1.51	0.73	—0.34
	11.2	2.74	2.76	—3.38	1.46	3.06	—0.32
	14.0	3.00	2.40	—3.20	2.21	3.10	—0.10
B	8.4	2.26	1.18	—1.68	1.46	1.97	0.29
	11.2	4.45	1.82	—4.26	1.04	4.38	0.10
	14.0	6.83	1.99	—4.93	2.16	5.88	0.95
S	8.4	1.09	2.09	—1.88	2.09	1.49	1.49
	11.2	2.29	2.80	—1.29	1.79	1.79	0.50
	14.0	3.78	0.98	—1.51	1.62	2.65	1.14
Wh	8.4	—1.34	1.37	—1.09	1.09	1.22	—1.22
	11.2	0.90	1.82	—1.54	1.93	1.22	—0.32
	14.0	0.05	0.92	—4.09	1.60	2.06	—2.02

Quantitative Results.

Table VII shows the quantitative results of Series 1. From it the following results are apparent:

1. With two exceptions, every value indicates an error of expectation.

2. For all observers, the expectation error increases with the increase of D:[2] this is shown by the progression in the col-

[1] It may be noted that *Wh* was, at least at first, at a slight advantage. He knew that there were three standards, three D's, and that the rate of change was uniform; yet the observers were soon put upon nearly equal footing because (1) the knowledge of the number of standards was of no practical value, (2) the other observers soon came to the conclusion that three (or four) different D's were in use, and (3) they were told early in the first set that the rate was uniform, and that V never started at equality with N.

[2] To anticipate the qualitative discussion somewhat, it may be noted that the two exceptions just mentioned both occur with the smallest D, *i. e.*, under conditions such that a momentary cautiousness or a slight effort to combat expectation will suspend reaction too long and

umn of the average limit of error.

3. The mean variations are large.

4. *M* and *Wh* constantly underestimate, *B* and *S* constantly overestimate N. This feature is of itself indicative of some individual differences in the manner of judging, so that we are led to examine the judgment consciousness as it is revealed by the introspection.

Qualitative Results.

A. Features common to all observers.

The introspection throws light upon several minor features; *e. g.*, the manner in which the position of V is first known, the nature of its movement, the existence of a curious 'after-tone,' etc., besides yielding, what is more to our point, a satisfactory analysis of the judgment-consciousness. The chief matters of interest in this analysis are the direction of the attention, the ultimate basis of the judgment, the influence of expectation, the feeling of assurance, and the nature of the reaction movement. These factors must, for the most part, be discussed in the light of the reports of each observer separately. But in five respects, viz., the knowledge of the position of V, the nature of the movement of V, the nature and influence of expectation, the 'after-tone,' and the assurance, the reports of the observers exhibit such community that these topics may be profitably discussed at the outset.

Knowledge of the position of V. Observers *M*, *B* and *Wh* as a rule knew N as soon as it sounded; *S*, as might be expected from her poor sensible discrimination, had more difficulty and frequently relied upon her observation of the direction of the movement to gain her knowledge of the position of the starting point. However, the wider D's offered little difficulty. It is of interest to note that large D's produce in an exaggerated manner the organic shifts which have already been reported as characteristic of the 'higher' and 'lower' feels of compared tones. For example, the slight feeling of relaxation which was noted by several observers in the tests with discrete tones (D = 8 vibs.) became exaggerated into a very distinct slump or depression when V differed from N by 14 vibs. "V caused a sudden feeling of drop, very like the feeling you get when you wake up suddenly thinking you are falling" (*B*). "The recognition of the place of V above or below the image is nearly always immediate, and similar to that in

equality will be passed. Both the observers in question, *S* and *Wh*, note this explicitly; *e. g.*, "Feeling the error of anticipation, I now have a tendency to restrain the reaction. With a small D, therefore, the time to equality is so short that I overdo this and react too slowly."

the discrete experiments, except that it always seems to come as a shock or blow, a change of bodily attitude of some sort" (*Wh*).

The movement of V. The variable tone seems practically never to progress steadily towards N, but to move by stages which may be regular or irregular. *S*, who uniformly experienced a lively visualization of the progress of the tones, was able to illustrate this movement graphically. The following reports will indicate more clearly what is experienced: "V moved slowly toward my image which I kept clearly in mind. When yet a short way off, it jumped to it by a wide step and fused with it." "Jumped to equality on the second slur. I had to react, though I suppose it was too soon." "V came down by a series of swoops. Finally one was almost at equality, but I said to myself: 'wait till the next.' At the start of the next plunge I saw suddenly that it had passed, and I reacted as quickly as possible, but with disappointment at the failure" (*Wh.*) The number of stages depends largely upon the amount of D; when D is 8.4 vibs. the tone usually makes 3 or 4 steps; when D is 14.0 vibs. there are 7 or 8 steps to equality. It will readily be seen that the existence of these stages plays an exceedingly important part in the mechanism of the judgment.

Expectation. The existence of a large expectation error is one of the most striking results of the continuous change method. It is very apparent in the quantitative results of Table VII where, with but two exceptions in 24 cases, V_o ||| N is represented by a positive, and V_u ||| N by a negative sign. This table also shows very clearly that the amount of expectation is largely increased by increase of D. The existence of expectation is also very apparent in the qualitative reports. One of the most regularly recurring features is a tendency to premature reaction. It is scarcely too much to say that in *every* test, the observer experiences from one to more impulses to react before actual movement is carried out. The introspection shows, however, that this expectation tendency is not always due to a single motive. We may distinguish several contributory causes. First, in the case of a large D, expectation may result from the very fatigue of waiting for equality. The pitch interval of 14 vibs. demands, at the rate we have employed, ten seconds for its transition. This is a long period for active attention to the variable tone when the observer has already been taxed with the effort to retain the image, or whatever stands for the position, of N during an empty time-interval of 10 seconds before the variable stimulus appears at all, and when he is still further taxed with the effort to maintain the position of N through the ten seconds dur-

ing which V is sounding. It is small wonder, then, that despite the precautionary check to hasty reaction which the wide D itself affords, the observer should yield to the temptation to "have it over with." This occurrence is frequently reported thus: "With a wide D, I get tired of waiting." "D was wide and the strain on the attention so great that I reacted even with the thought that it was not yet quite equal; but still I felt that I must get through with it." "When D is wide, I now make a distinct effort not to hurry, but still I react too soon" (*B*). Again the expectation may be set and released at a definite point, this point being determined by an estimate of the amount of the D.[1] In these cases, obviously, the judgment is determined by the lapse of that amount of time, which, it is inferred, should bring V to the point of equality. Here, however, we may regard this process as one phase of the expectation tendency. This influence may determine the judgment quite by itself, or it may modify the natural course of the reaction which would otherwise ensue, *i. e.*, frequently an observer says he felt that V must have reached N, although equality had not yet been attained on the basis of auditory recognition. Illustrations are: "Felt it must be time to react though V was not quite back to what I wished" (*Wh*). "Was n't quite there, but felt it ought to be, probably from my previous estimation of D" (*B*).

Finally, there is a simple sort of expectation which is a very potent factor in the judgment consciousness, but which cannot be more accurately defined than a dread of getting past equality. Apparently the feeling is that, once equality be past, one would be helpless, for the moving tone would then be constantly getting *away* from the desired point. Perhaps this interpretation is too much logical, and too little psychological, but, whether or no this much is in the observer's mind, the action of some such motive is very evident from the following examples: "Scared stiff for fear of passing equality." "There is still almost as much excitement now as at first. I can't look at the matter calmly" (*M*). "I get worried when V approaches N for fear it will get away from me" (*S*). The experimenter can attest that this expectant attitude is clearly visible by all the usual outward tokens of the keenest sort of attention, which culminates, at least, during the earlier tests, in distinct agitation at the crucial point. Now it would seem very probable that so vivid an expectation would be noted by the observers, and that deliberate attempts would be made to counteract its influence. We have already quoted extracts which show that

[1] This point will be further discussed below when the basis of judgment is mentioned.

such is actually the case. What is most remarkable is that, save in exceptional individual tests, this deliberate inhibition of the tendency to premature reaction is never adequate. When the observer is making a conscious effort to retard his judgment, and when this effort seems to him to have been adequate, or more than adequate (so that he complains that he has passed equality, has waited too long), even then the subconscious tendencies prevail, and an expectation error appears. "With wide D's, I now make a distinct effort to wait" (*B*). "I think I now generally wait a little after V seems at equality to make fully sure of it." "There is an area of equality. If I am excited, I react as soon as I get to it; if cool or confident, I wait till I am well within this area" (*Wh*). Often the natural influence of the wide D to heighten expectation is combated with varying success by the time inference; *i. e.*, that since D is wide, it will take more time to reach equality. The resultant reactions are thus subject to noticeable variations. This is one of the influences which produce such large mean variations. A single case will illustrate. "A very big D going down. . . . . I passed through a period of seeming equality, felt it time to react, but hesitated (probably because D was wide and the time then elapsed but short); then, after a tonal *difference*, entered *another* period of equality and reacted" (*Wh*). [Result, still 0.6 vibs. too high.]

The after-tone. It will be remembered that the moving tone was arrested by the direct action of the armature of an electromagnet upon the gear wheels: the actual movement was very short, and its inertia was reduced to the lowest point by proper adjustment of the springs controlling the armature; nevertheless, all four observers quite independently noted that after the key had been pressed there was a distinct additional movement of the tone. By listening to this 'after-tone,' observers *B* and *S* quite frequently, *M* less often, decided whether the reaction had been made too soon or too late, and in this manner they evolved a sort of control over their natural expectation error.[1] Typical reports are: "After judgment is made and the key pressed, V has moved some since my decision (*S*). "After reaction, noted after-tone and thought 'I should have waited longer; that tone was nearer the right one'" (*M*). "At the moment I press the key, the tones seem equal; then immediately afterwards I listen to V and see that I did not wait long enough" (*B*). "At judgment, thought 'too low,' but after-tone seemed about right" (*B*). To obviate this peculiar influence, it became necessary finally to put in the reaction circuit

[1] *Wh* noted the tone, but did not use it as a corrective of his judgments.

a rather loud 'buzzer;' which sounded whenever the key was pressed, *i. e.*, simultaneously with the action of the armature clutch. The intensity was sufficient to drown the bottle-tone. The introduction of this noise, however, did not, curiously enough, accomplish the purpose for which it was intended, for despite the sound of the 'buzzer,' *B* and *S* occasionally reported the after-tone. More careful observation then brought out the real nature of the phenomenon. The so-called 'after-tone' is in reality due to a subjective process,—the formulation and execution of the judgment withdraws the attention for a very short time from the stimulus. The observer then hears that portion of the moving tone which sounds after his impulse to react and before the action of the clutch and the noise buzzer stop both the movement and, so far as the observer is concerned, the sound of the variable tone. This explanation will be clearer when the nature of the apparent movement of the variable tone and the influence of expectation are recalled. The movement of V takes place not uniformly, but by a series of slumps or slurs. One of these sudden changes may take place just after an impulse to react matures. The general effect of expectation is, we think, to cause the incoming variable stimulus to seem nearer the standard than it actually is. When the test is completed by the decision, the influence of expectation is suddenly thrown off and the observer hears the tone quite distinctly different in pitch from the tone noted a moment before when the key was pressed.

Assurance. From the very nature of the continuous change tests, one cannot expect the observers to exhibit that degree of certainty which is obtainable in the tests with discrete stimuli. There the answer was definitely right or wrong. Here only a very happy chance can bring the reaction movement at precisely the fraction of a second when V is passing the point of equality. The influence of expectation and of the attempts to counteract it also plays some part in lessening the observer's assurance.

We prefer to speak rather of the observer's assurance than of his certainty, and to retain the latter term for the method of judgment, for, in the present case, no observer can say definitely that his reaction was made at precisely the proper moment; he can only feel an assurance that it is "pretty good," "somewhere near," or "the best I could do." As *Wh* expressed it, there is not a point, but an area, of subjective equality, and that reaction is felt to be satisfactory which is within this area. Even so, the assurance of the observers is never very great. It is often affected either favorably or unfavorably by the after-tone. The following are typical reports: "V not like my image, but the nearest thing that had come."

"Judgment rather uncertain. Thought it too slow at first, then, hearing the after-tone, decided not." "After reaction thought I had only reached the *edge*" (*M*). "I never get any definite recognition, but I stop the tone when it is near it. Don't usually know the direction of error" (*S*). "Not just right, but don't know which way the error is" (*B*). "Decision fair, but not a 'dead-sure' feeling" (*Wh*).

B. Features peculiar to individual observers.

We have just discussed certain features of the qualitative results of the continuous change method which were common to the reports of all the observers. This discussion revealed the existence of a peculiar after-tone, largely subjective in nature, which was used to control decisions, and of a strong expectation tendency which was fostered by several contributory motives, but counteracted by conscious attempts at restraint. Furthermore, it was shown that the perception of the starting-point of V, and that of its movement, involved practically similar experiences for all observers. The degree of assurance was quite similar for all. One might, therefore, suppose that there would be little room for individual variation in the reaction-consciousness. But such a supposition is too hasty; it neglects the fact that the passing of a single decision is the result of the operation of a very complex tangle of mental processes, of the function of a fairly large number of factors, each of which has its own special influence upon the outcome. Indeed, it seems, in many instances, impossible for the best trained observer to unravel the tangle, and to designate the amount of the influence which is to be ascribed to each of the factors in operation. We must be content if the observer can indicate the striking mental structures in every particular test, and if he can, in the course of a large number of introspective reports, indicate, from time to time, the less obvious structures which are to be found in his typical experiences. In this way, we can hope to obtain, in the first place, a tolerably accurate knowledge of the general process of judgment for each observer, and, in the second place, an account of the one or more particular features which have been prominent in each single decision.[1]

[1] One of the most interesting things which appeared in our reports was the tendency of the observers to specialize upon some particular introspective feature during each sitting. Thus, to take a single example, *S* gives her attention on one day quite exclusively to visualization, on another to temperature associations, on a third to the nature of the familiarity feel. This tendency reminds us of the readiness with which the observers pick up suggestions as to the probable content of the judgment consciousness (first article, 424). This emphasis upon certain phases during certain groups of tests must be fully

Perhaps we may simplify the consideration of the reaction-consciousness, if, while recognizing the truly unlooked for complexity of its structure, we attempt to outline some of the main directions in which individual variations may be expected.

I. As we have already pointed out, the attempt to restrain the expectation error may be successful or unsuccessful, nor can we predict, even in the case of a single observer, kept under constant objective conditions, that the outcome will be uniformly in favor of either tendency.

II. Some observers have a distinct emotional preference in regard to the direction of V, *i. e.*, they prefer to listen to a rising, or to a falling, variable stimulus.

III. The attention may be directed (*a*) uniformly upon the image of N, (*b*) uniformly towards V, either (1) directly upon V itself, or (2) indirectly upon V by the use of an anticipatory, changing image,[1] (*c*) alternately upon the image and upon V, either (1) by a series of rapid alterations, or (2) by a single shift to V near equality.

IV. The basis of the decision may be (*a*) tonal, in terms of (1) equality, (2) familiarity, (3) some change in V, (*b*) visual or visual-motor, (*c*) an inference in terms of the elapsed time.

V. The reaction movement may be (*a*) entirely automatic, or (*b*) an occasional source of distraction.

VI. There may be possible contrasts with preceding tests.

If, to these possible variations, we add the existing variations in the individual capacity to attend to the stimulus and to retain the memory image which our preceding tests have brought to light, as well as the variations in the sensible discrimination of our observers, we shall be prepared to find large mean variations in the numerical results and noticeable points of difference in the introspective verdicts.

Observer M.

M prefers to have V 'settle.' Once there was a curious illogical experience. V rose and went past equality without at any time passing through equality. The reaction was too soon; apparently expectation was excessively strong.

The usual *method of decision* is to hold the image as long as possible, then to turn the attention to V (which is, by this

realized in the interpretation of the introspection, and not too carelessly ascribed to the objective conditions of the series in use at the time. Moreover, we think it likely that this sort of 'auto-suggestion,' if that term may be used, may lead the observer to occasional bits of faulty introspection. Thus, during one of her 'temperature days,' *S* gave the following rather doubtful case: "Image not very good. The electric lights went on just before the test: seems as if they made me feel warmer, and therefore sharped my image."

[1] See under observer *Wh*, pp. 237-8.

time, near equality). The reaction occurs when V, by becoming (subjectively) more intense and "bigger," signalizes the matching-point, or when, as a result of rapid comparisons, there is an auditory or a visual 'match.' As in the tests of Parts I and II, *M*'s experience is suffused with lively visual and visual-motor imagery which is often of assistance in the decision.

The *movement of reaction* is apt to demand conscious attention.

These points are illustrated by the following introspective evidence: "Followed V down with my eyes in my imagination. Compared V with N twice at intervals, then two very quick ones when it got near." "Held image till V got near, then made two comparisons." "The series of auditory comparisons is pronounced in the form of a series of verbal judgments,—'too high,' 'too high,' 'high,' 'there.'" "V seems to swell out and get more intense at the point of equality, and this helps the judgment This is very comforting; reminds me of the apparent spread of the æsthesiometric compass when it comes to a more sensitive area." "N on a plane by my eyes. V moved up vertically till it coincided." "N was like a caterpillar, fuzzy, yet too small in the middle, a thin thing, and very hard to remember. When V got fuzzy and thin and removed the image, I reacted." "Lost the image finally, so attended to V which recalled N at the time of the reaction." "Hate the bell; it laughs at you when you are wrong." "Frequently have to think of the button at the reaction, and this is felt to be a confusion and a bother."

Observer B.

B prefers to have V move down; it is easier to react then than when V moves up. In the latter case, there is more strain and nervousness, greater expectation, and a change from the usual method of judgment, much attention being given to the image.

The usual *method of decision* is to give full attention to V, the image being present, if at all, only feebly in the background. "I attend only to V, not comparing it at all with N. The image is hardly ever present in the reaction consciousness, and not usually present at all after V sounds." There may be, as we saw in Part I, an attempt to use the image in unusually difficult cases. "I react by attending to V and watching for a feeling or coloring of the tone which means equality. If this seems too difficult, I pull up the image for comparison, but it is very confusing to try to hold the image and attend to V at the same time."

The amount of D at which V starts exercises a strong influ-

ence upon the reaction consciousness of *B*. Very frequently the actual movement of reaction is entirely determined by this means, in other cases its approximate time only. Thus if D is large, expectation may be increased or a sudden caution be born. "Was n't quite there, but felt it ought to be, perhaps from a previous estimate of D, so I reacted." "At wide D's, I often now make a distinct effort to wait." "As soon as V sounds, I determine about how long it will take to get back." "Not much D, so I thought 'it won't take long to get there.'" "A wide D demands too much strain of the attention; sometimes, however, it makes me cautious and I go slower."

This observer, though very musical and generally recognizing the position of V at once, had several peculiar experiences with the *movement of V*. "Went up too fast at last; a sudden jump made V really too high at the decision." "V started at or near equality. At any rate, it never was equal to N at any time save possibly at the start." "V started right on N, I am positive." With one test (D= —11.2 vibs.) nine trials were necessary before *B* interpreted the conditions correctly; eight times it was reported that V began at N, or below N, and went lower yet. Finally *B* announced in despair "I 'm all mixed up; I believe you are playing tricks with me."

Expectation and the time factor. The persistence with which the expectation error appeared in the case of *B*, and the rather striking fact that this error increased as D increased by nearly the same amount, led to the suspicion that *B* was reacting almost entirely in terms of time; that, for some reason not clearly obvious, the movement of reaction took place at practically the same time after the sounding of V, notwithstanding the three very different values of D in use.[1]

A series of 'puzzle-tests' (*Vexirversuche*) was accordingly planned to discover whether *B* was influenced by some 'habitual-time' tendency, analogous to an 'optimal-time' influence. In these tests variations were tried in the amount of D (using 0, 5.9, 9.8, 15.4 and 19.6 vibs. in place of the usual values), and in the direction of V, which was kept at zero, or moved away from N, etc., etc. The regular time-interval, 10 seconds, was employed. Not until *eight* such tests had been given did *B* suspect anything unusual. She then exclaimed: "that tone went the wrong way, though I first thought it was moving up. I 'm afraid you are trying to trick me." This is a very forcible illustration of the confidence which the routine of a long continued experiment will inspire.

[1] The alternative explanation is that the expectation error increases uniformly with increase of D.

So habituated was *B* to the method of procedure that eight puzzle-tests were required to shake this confidence. In several of the tests the unusual conditions produced curious illusions; thus V was given = N: *B* reacted after 3.6 seconds, giving as her report,—" V higher, ran down. Reaction possibly too soon, but very good. I can always tell that (!)."[1] These tests were continued until 25 were given. After the eighth, *B* became more cautious; at the 17th she concluded that new *rates* of change were being used. There still remained a surprising amount of confusion as to the position, but more especially as to the direction of V. Thus, V was once started 11.2 vibs. below N and then *lowered* at the usual rate, after nearly 15 seconds, *B* reacted when V was 31.8 vibs. below N or 20.6 vibs. below the starting-point of V. According to the report, " V at first went up; then it seemed to get more piercing, and for a long time I could n't tell which way it went. Finally it got milder and nearly like N, but the judgment was probably a little low."

If we compute the length of time from the sounding of V to the movement of reaction, we find, for the three values of D used in the regular tests, *i. e.*, for 8.4, 11.2 and 14.0 vibs. respectively, the following periods in seconds,—[2] 2.46, 3.58 and 3.18. If now we compute the corresponding values for the new D's used in the puzzle-tests, we find for 5.6 and 9.8 vibs. the values 3.84 and 3.70 seconds respectively.[3] The average for these 5 D's is 3.35 ± .43 seconds. This result is confirmatory of our hypothesis of an ' habitual-time.' It may be worth while to recall here the test mentioned above in which *B* reacted to a V = N after 3.6 seconds. We conclude, from these indications, that *B* is influenced by a very strong tendency to react at about three and a half seconds after the sounding of V.[4] This

[1] *Cf.* Stern, *Veränderungsauffassung*, 94; Seashore, *Studies from the Yale Psych. Lab.*, III, 1895, 29 ff.

[2] These values do not correspond with those given in Table VII because they are the average for those tests only which were made before the puzzle-tests had made *B* more cautious.

[3] The remaining puzzle D's, 15.4 and 19.6 vibs., were so unusually large that it is too much to expect that the elapsed-time influence should make itself felt without restriction. Their values, 5.02 and 5.90 seconds, are accordingly omitted.

[4] Despite the differences in the conditions, it seems quite probable that this influence is akin, if not identical with, Stern's ' optimal-time.' At any rate his times (3.3, 3.9, 3.7 seconds) are curiously like those obtained by us, and the statement of the law (p. 236) might equally well apply to observer *B*: " Wenn jemand einen Veränderungsreiz stetig beobachtet und den Wahrnehmungsaugenblick selbst feststellen soll, so tritt um etwa vier Secunden herum eine kritische Zeit erster Ordnung ein. Die Aufmerksamkeit ist auf's höchste gesteigert, die Erwartung drängt zur Entladung, und das abschliessende Urteil wird, wenn irgend möglich, gefällt: hierbei ist dann die ob-

tendency makes itself felt almost entirely in tests in which D is plus.[1] Very likely this is correlated with the preference above mentioned for a descending variable because of the ease of judgment then. The 'ease,' we think, is due to the control exercised by this unconscious 'time-release' factor.

Observer S.

One of the most prominent features in *S*'s introspection is the *identification of N* by the use of several different categories. This seems to be partly a relic of the procedure with right and wrong cases[2] (each N being, as soon as heard, compared with the N of the preceding test), and partly a desire to gain a feeling of order and security in the work by arranging a schema of the standards in use. *S* thought at first that there were six or seven, later three or four standards. These appeal to her as differing from each other not only auditorily, but in temperature[3] and size, and occasionally in other respects, personal characteristics, etc. "N places itself in my scale auditorily, visually and in regard to its temperature, and remains placed there throughout the test. The warmest N is comfortably warm, more than lukewarm; the coldest is just like pleasantly cool water, this being the lowest tone used. Some tones are masculine, others (generally the higher ones) feminine." "Could not place this N in my series, and this bothered me as it gives me confidence to get N put readily into my scheme of identification."

Though, as might be expected, this process of identification was not always successful, the assignment was more often than not correct. There is no question but that the contribution supplied by the other sense departments is the essential basis of this process. *S* knows that a given N is a cool one before she knows that it is (relatively) low in pitch. Here we have a striking illustration of an unusual and unlooked-for means for the recognition of the impressions of one sense department in terms of another. It seems quite unreasonable, logically, but not, after all, so unreasonable psychologically, for, as we have already pointed out, *S* has a poor auditory discrimination, but a very strong affective reaction to tones. It is this affective supplement which catches the attention, therefore, and which gives individuality to the various standards.

The same prominence of *visual factors* which characterized *S*'s experiences previously appeared here again with even

jective Grösse, welche die Veränderung in jener Zeit erlangt hat, innerhalb weiter Grenzen irrelevant."

[1] The figures just given all refer to a descending variable tone.

[2] *Cf.* especially 439 (6) of the first article.

[3] *Cf.* first article, 420, 428, 437, 451.

greater distinctness than before. We have said that N seemed to have a certain visual size and place. V invariably evokes a still more pronounced visualization, usually described as "a smoky, gray round thing moving up or down and making a rope as it goes. " I watch the moving end or knob. N is a similar round stationary thing at the left of V. I seem to stay on the V side and look towards the image on the left. When V goes down it drops vertically, but when it goes up, it always moves obliquely out away from me at an angle of about 45 degrees." The visual phenomena thus described are not so active as determining agents in the reaction consciousness as those which serve to identify N. Here they are, as *S* puts it, rather the expression of the auditory relations between V and N.

The actual *decision* is usually either (1) the result of a series of auditory comparisons (the attention being for the most part on N, and jumping over to the image for a moment), or (2) the result of some modification of V. It is noticeable that the latter type of decision became more prominent as the work progressed, less and less importance being attached to the image. This is entirely in accordance with what we have already had occasion to mention so frequently,—that the process of image-comparison is used in cases of difficulty when the direct method is, for any reason, not available. The modification of V may be an auditory swelling, as in the case of the observer *M*, but oftener it takes the form of some organic or affective response. " Reaction based this time upon a certain individuality which appeared in one place in V,—something auditory perhaps." " When I reacted, V ' stood out,' was ' my tone.' " "At times, at the moment of reaction I see a whitish convex thing which appeals to me as something graspable; the rest of the tone is not thus graspable." (3) A third, somewhat less frequent, basis for the decision is the experience of a sudden *bodily glow or warmth.* We may suppose that this is a constituent of the organic reaction which forms the essence of the ' mood of familiarity ' or ' quality of knowness ' for this observer, but like many constituents which enter into rapid and complex mental processes, its presence is only distinctly made out in occasional introspections when the conditions favor analysis. It is credible, too, that *S*, who experiences strong affectively colored associations of temperature with tones, should, on that very account, be the observer to analyze out this particular feature of the familiarity feel most successfully. On the other hand, *S* herself says that the warmth which comes with recognition is quite distinct from that which is ascribed to tones. The former is experienced in other cases than in the recognition of tones; it comes, for example, when the point of an argument in a lecture becomes suddenly clear.

The similarity of this case to the recognitory consciousness in our tests is not very difficult to perceive.

There remains to be mentioned, in the case of *S*, a strong preference for a rising V. "It is pleasant to have V grow strong and big, depressing to feel it sink." One may accordingly explain the overestimation error as due to an unconscious prolongation of the pleasurable movement of rising variables, or to an unconscious premature checking of the depressing movement of descending variables.

It has already been mentioned that *S*, owing to a poor sensible discrimination, had, at times, difficulty in perceiving the *position of V* at once, especially with the smallest D. Frequently the actual movement of the tone supplied the desired knowledge. In nine out of 36 tests, however, *S* carried out the tests completely and then reported that V moved in the opposite direction to that actually executed. These tests were given again (being interspersed in a regular series) until correctly interpreted. A single repetition was sufficient in six cases, three or four in the others. In five cases, D was 8.4 vibs., in two cases, 11.2, in two cases, 14.0. These rather anomalous results raise an interesting point. How are we to interpret the quantitative value of *S*'s tests, especially her estimate of equality, when, to take one example, V was descending from 14.0 vibs., and *S* reported: "V went up, a good swelling tone; judgment of recognition?" A more hopeless confusion of the objective conditions could scarcely be imagined in view of the long practice *S* had had. We are still, however, ready to assert that the reaction might quite well have indicated a real recognition of the merging of a difference into an equality. The results of *B*'s puzzle-tests show how easily the direction of a movement of a continuously changing tone may be mistaken. It has, again, often been asserted, and our previous results have everywhere confirmed the assertion, that difference is more readily noted than the direction of the difference. Finally, we have shown how dependent *S* often is upon supplementary contributions from other modalities for her perception of tonal relations. The introspective evidence points clearly to the influence of these contributions in producing many of the confusions. If a tone seems to be 'swelling,' or is visualized in the wrong position, this is enough to override the direct perception of its auditory relations. *S* herself says: "I think I am too much influenced at times by my visualizations." We may conclude, then, that in the case of *S*, some one of a number of extraneous factors causes a misapprehension of the proper place of V; this influence is so strong that, coupled with the general difficulty of perceiving the direction, it overrides the objective conditions. However, *S*

knows that V is different from N, and makes a satisfactory reaction when it reaches equality.

S noted occasionally a short but distinct interval between the formation of the decision and the pressing of the reaction key.

Observer Wh.

The method of decision in the case of *Wh*, although it changed as the tests progressed, was throughout much more exclusively auditory than that of the other observers. At first there was a series of auditory comparisons. But very soon comparison was given up, although the auditory image was still maintained by effort during the time-interval, and, as long as possible during the sounding of V.[1]

The common method pursued by *Wh* is thus that in which the judgment is auditory-motor (or auditory), the attention being held upon the image with all possible persistence, not alternating between the image and N, but merely waiting for coincidence. When, however, D is large, there are what *Wh* calls occcasional 'looks' at V (not comparisons or 'balancings,' but brief shifts of the attention).[2] "I image the ideal tone as soon as V sounds and keep this ideal in mind somehow, but toward the end my attention 'flops over' to V, and I come down with it to the place (*i. e.*, N) from which I had jumped to it. The 'flopping over' has a distinct motor feel about it." "Once I tried so hard to think the image that I did n't attend to V at all, so that the decision was very uncertain. Found no equality point at all." "I still hold to the image, but it seems a place in space to get to quite as much as an auditory quality, for the tonal image is not distinctly present."

The second chief method used by *Wh* is a peculiar one, for the attention is not directly upon either the image or V; in fact, there cannot be said to be any image in use, in so far as we mean by the image a representation of N. As V moves along by a series of slumps or slurs (descending or ascending V respectively), *Wh* at each stage imagines what the next stage is to be. Perhaps an introspective report will make this clearer. "I attend in a way to V, yet I am, so to speak, go-

[1] Naturally, as we have seen in the case of the other observers, when V gets so near N that it becomes a source of confusion to the image, the attention, compelled by the insistence of the sounding tone in contrast to the natural feebleness of the image, is very apt to go over to the variable and be held there until the reaction. As the tests continued, the spatial characteristics of the image became of more importance, and the image (we use the term for whatever is held in consciousness to represent N) lost much of its auditory nature.

[2] In distinction, for example, from the procedure of *M* in passing a series of verbal judgments.

ing ahead of it auditorily and coaxing it along; mentally hearing it take its course from difference to equality just in advance of the tone itself. When V has completed the path I thus made for it, I react."

Finally, *Wh* uses occasionally the method already mentioned of relying solely upon some change in the (subjective) nature of V or upon the appearance of some familiarity feel. This form of decision is not used by this observer save when other means fail. "Distinct swelling of V at the right place." "No image at V, so attended to V to see when it got familiar. At a certain area it aroused a 'familiarity tag' and the reaction. I'm not at all sure of this sort, rather have some idea of the place of N in mind all the time." "When D is very large, I sometimes lose my image-place entirely and have to go by the familiarity feel."

The *amount of D* did not exercise over *Wh* so great an influence as upon the other observers (especially *B*). Occasionally, of course, a wide D increased the tendency to premature reaction: "Big D; had a strong expectation which made the rate of V surprisingly slow." More frequently quite the reverse effect appears: "Pleased with wide D, for then there is plenty of time. I can be calm and make the reaction coolly."

The influence of D as a determinant of the reaction by a computation of the time necessary (*i. e.*, quite apart from its influence upon expectation) seems not very strong with *Wh*. While cases appear like those of observer *B*, there are many others in which the estimate of the size of D, instead of determining the moment of the reaction, is itself revised by the influence of the other factors in the judgment consciousness. "I thought the D was small, but the tone was some time in reaching equality, so (as I know this means a wide D) concluded I was mistaken in my first thought."

The *movement of reaction* "seems now to be fixed, united with N, in such a way that whenever V reaches N, the reaction 'goes off,' usually quite automatically." "Just before V gets to equality, I put my finger on the key, my arm muscles set for the movement, and feel in general a very pleasant anticipation of making the reaction. It is a sort of 'hitting the nail on the head' feeling, or like chopping a running rope at some fixed point."

Series 2.

This series consists of 36 tests for each observer, identical with those of Series 1, save that the time-interval is 40 seconds.

The *quantitative results* are extremely irregular, so much so that it is useless to present them in tabular form for extended

comparison with those of the other series. It will suffice to point out, for example, that in five out of 24 cases the expectation error disappears, that there is, in the remaining cases, no sign of any relation between this error and the size of D, that the mean variations (except for *S*) are uniformly larger than before, that the estimation value of N is not constant in sign for any observer (save for *B* who underestimates with all three values of D).

The cause of this rather unsatisfactory outcome from the quantitative point of view is not far to seek. It is due to the fact that, to the natural difficulties of the continuous change method which we have just discussed in detail, there is added the difficulty of the long time-interval.

The *qualitative reports* are quite as irregular and quite as difficult to put into tabular form as the quantitative. To begin with, the observers differ very much in their use of the auditory image. Thus, in 36 tests, *M* reported 25 cases in which the image was present in the decision (in 22 of them after having persisted throughout the interval), three in which it was not present, and eight unclassified; *B*, on the contrary, reported only 10 cases with the image and 13 without it, while the remaining 13, in which this point was not explicitly settled, probably belong to the latter type. *S* makes use of her visual images quite frequently; *Wh* reacted with an auditory image 16 times, without any 13 times.

Despite these variations, the following general propositions may be laid down. (1) Owing to the long practice now attained, the auditory image can be held somewhat better than during Series 3 of Part 2. (2) The presence of the image (even if the auditory core is lacking) affords greater assurance in the reaction. (3) It is helpful to have the image persist in some form until V starts, even if it does not enter consciousness again; to have in mind a definite place for N when V begins, because recourse is thus had to a decision based on the amount of D. (4) It is, however, possible to make an objectively satisfactory reaction when the image has been permanently lost before V sounds. Such reactions are most frequent for observers *B* and *Wh*. *B* finds them subjectively satisfactory, *Wh* much less so. The actual basis of the decision of this type varies. If the recognition seems rather hopeless, the observer is apt to catch at the slightest indication of equality. "Image entirely gone, yet knew V started below. This time, however, I had neither a tone nor a place in mind for V to reach. So I watched V to get a familiarity, but reaction was really largely due to a feeling that V had gone on long enough" (*Wh*). "The familiarity feel seems to be something bodily which comes on gradually and finally engulfs me" (*Wh*). "Sometimes the visualized

note becomes a warmer gray at the moment of decision" (*S*). "V seems to 'splay' out or extend itself horizontally when it gets to the proper level" (*Wh*). "Just watched V and waited for myself to react, automatically, as it were" (*Wh*).

In Series 1, we saw that *S* and *B* had occasionally anomalous tests in which the *position and the direction of movement of V* were not correctly apprehended. The long time-interval of Series 2 magnifies this difficulty, so that we find five such cases accredited to *M*, nine to *B*, 27 to *S*,[1] and four to *Wh*. Now it is worth while to examine these cases in more detail. For the sake of simplicity, let us class them according to the apparent starting point of V. The resulting distribution is, then, as follows: started at equality and went up, 3; started at equality and went down, 2; started above, 2; started below, 17; miscellaneous movements[2] and totally unrecognized cases, 19. The pertinent feature of this distribution is the predominance of the cases in which V seems to start from below. Taken with the prevalence of comments by the observers upon the ease with which the position of V is recognized when it does start from below, we find confirmation of the principle upon which we insisted in Part I, viz.: that, for most observers, there is a tendency to sharp the image in the case of a long time interval.[3] Whether the auditory image is actually present when V

[1] One is, perhaps, warranted in saying that for *S*, discrimination by the continuous change method is practically impossible with this time-interval. *S* was tested roughly for S. D. by the aid of the piano, two notes being struck one second apart and the judgments 'equal,' 'higher' or 'lower' being required. The results for musical intervals from unison to the octave gave 94 per cent. right cases, the wrong cases being entirely confined to a single interval, the major second. Incidentally it appeared that *S* was liable to mistake a difference of intensity for a difference of pitch. This tendency was further investigated by special tests and the result confirmed; it was also found that a variation in the intensity of the stimuli would influence the estimation of the relative size of intervals, and that minor intervals were usually overestimated. These results simply bear out our general contention that *S* is very unmusical and that, in the more difficult series of our experiments, the task imposed was beyond *S*'s capacity for *sensible* discrimination.

[2] This class includes a variety of combinations of which the following are examples:—"V appeared equal. Don't know which way it moved."—"V seemed to start below and yet to *go down*. I was determined to have it go up, and tried to make it do so in vain." "Began slightly lower, surely, but did n't approach N. Stayed on same pitch or wabbled around it." [In this case D = + 14.0 vibs., really. A striking illustration of the influence of expectation with observer *B*. The erroneous preliminary estimate of the position of V sufficed to suppress completely the perception of the actual movement of the tone. Very likely the "wabble" was due to an actual alternation of attention between the expected and the given direction of movement.]

[3] See first article 422 (2 *b*), 426, note 1, 432 (5 *a*) and note 2.

starts or not, the fact that its pitch (and also, as a rule, the various organic sets and other associative supplementings) has been gradually raised in the endeavor to maintain it as vividly and clearly as possible, brings it about that the 'level' representing the place of the standard has been altered at V. Putting the matter in another way, the unconscious, gradual sharping of the image during, say, 30 seconds, will affect the identification of V at the 40th second, even if the auditory image has ceased to be consciously present. "Image absolutely gone, but V immediately aroused a verbal 'high,' and was felt to be *so* high. I knew at once approximately *where* the image must have been, though I did n't hear the image sound again" (*Wh*).

In connection with the gradual fading of the image and the difficulty of maintaining it in serviceable condition for the 40 seconds interval, there should be noted a very frequently reported phenomenon, that of the *arbitrary alteration or displacement of the auditory image*.[1] Apparently the auditory image is not always the determinative feature of the complex which stands for N during the interval. The observer sometimes controls the tonal image by reference to some other material as a basis. This scrutiny of the image is clearly illustrated in the ensuing quotations. "Two images during the interval. Knew the higher was the correct one." "Put this image too far down, misjudged it, so when it insisted on raising itself, I had to let it do so." "Lost image for awhile; then two came back, distinct from each other, auditorily and spatially. The real one was the upper one, but it had a tendency to fall down into the lower one, so that I had to keep pushing it up. It was a regular nightmare, like emptying lakes with a thimble" (*M*). "Changed my image during interval. Thought it too high and voluntarily put it down" (*B*).

Finally, there is to be mentioned the growing ability to *recognize and identify the three standards*. We see no reason to correlate this specifically with the use of the long time-interval; it may be attributed merely to the growth of special practice. *Wh*, possibly because his pre-knowledge of the actual conditions satisfied his curiosity on the point, did not develop any system of classification. *S* concluded that there were three standards or three groups of standards, perhaps two low, two high, and one in the middle. The lower standards were cold and colorless. *S* could frequently identify the standard by means of these associative tags, saying—"That 's a cold one," "That 's the warmest one," etc. This process made the test more easy of completion: "Not a good reaction because I

[1] Something of the sort was noted in Part I, *e. g.*, the double images of *F* and *Wh*, 430, 5*a*, 432, 5*a*.

did n't get N well identified in my scheme of standards." *M*, quite similarly, came to suppose that there were three groups of standards, with about three tones in each region. She could also frequently assign the standard to these groups correctly, *e. g.*, "That was one of the middle ones, neither high nor low; a very ordinary tone, hard to remember and discriminate. These middle tones seem more spread out, less graspable." "Sometimes the sounding of N clears up a sort of confusion which begins at the 'ready' signal [anxiety or curiosity about N]. It is like a ray of light coming through smoke. Even then, there is a fraction of an instant between hearing N as *a tone* and knowing it as *this tone*, a high one, low one, etc. This identification is quite pleasant. I often feel like 'shaking hands' with N, and saying 'Hullo, there.'"

Observer *B*, it is perhaps not too much to say, actually came to have an absolute pitch memory for the three standards. We say "perhaps," because the identification was of a peculiar sort. *B* did not say that a given standard was the high, middle or low one, although she thought there were three (or four) standards, but that a given tone was the one used in this or that test, usually recognizing the identity of standards in successive tests. The accuracy and the positiveness of *B*'s assertions are remarkable because often fully five minutes elapsed between the tests, and the report of the introspection sufficed completely to distract the attention from the auditory experience. Once *B* recognized V (instead of N, curiously) as identical with the V of the preceding test, but could not place it with certainty in relation to its own N. In another instance, the standard given in the eleventh test was positively identified as that given in the first test. *B* herself thinks this capacity is due to the fact that since the identification is not the object of the experiment, she is free from expectation and from the feelings of confusion incident to the task of reaction. But it should also be remembered that the identification calls for the discrimination of discrete tones only, that the three standards are 14 vibs. apart, and that there has been long practice with these same three standards. *B*'s identification of a given tone with a certain other previously experienced may still be, at bottom, a discrimination based upon an acquired absolute pitch memory of a moderate degree.[1]

A minor effect of the long time-interval is to lessen the *assurance*. "After V is 'placed' (higher or lower), I like to watch its movement for a moment to get added security." "If I have a bias for a given position of V, and it turns out other-

[1] *Cf.* M. Meyer, *Psych. Rev.*, VI, 1899, 514.

wise, my confidence in the outcome of the whole test is shaken" (*Wh*).

Series 3.

This series is a repetition of Series 1, but by the method of procedure with knowledge. The subjects knew that there were three standards, three D's, and they were told the direction, but not the amount, of the D for each test. The object was, of course, to see what effect, especially upon the expectation error, would result from the previous knowledge of the direction of V.

Quantitative Results.

TABLE VIII.

10 Second Interval. Procedure with Knowledge.

Obs.	D	V_o III N	m. v.	V_u III N	m. v.	Aver. Limit of Error.	Estimation Value of N.
M	8.4	3.08	0.86	—2.91	1.34	2.99	0.08
	11.2	5.35	1.29	—4.37	1.15	4.87	0.05
	14.0	6.30	1.20	—6.55	0.90	6.44	—0.14
B	8.4	—0.11	0.64	—1.46	0.90	0.78	—0.78
	11.2	3.02	1.43	—2.10	1.70	2.58	0.48
	14.0	3.58	2.10	—3.83	2.16	3.72	—0.14
S	8.4	0.86	1.45	1.23	2.94	0.71	0.71
	11.2	2.57	2.27	—2.01	1.60	2.29	0.28
	14.0	4.14	2.46	—1.45	2.01	2.80	0.92
Wh	8.4	—0.39	1.20	0.33	1.23	0.36	—0.06
	11.2	—0.11	1.09	—1.45	0.75	0.78	—0.78
	14.0	—0.08	2.10	—3.11	2.60	1.60	—1.60

Table VIII shows the quantitative results of Series 3. In comparing it with Table VII, one must bear in mind that the tests are relatively few in number, that the results are influenced by the increasing amount of practice, and that the procedure with knowledge is not, after all, very different from that without knowledge, for the difference lies mainly in the acquaintance with the coming position of V. Now, with the short time-interval, as we have pointed out, the observers, with the exception of *S*, had practically no difficulty in recognizing at once the position of V. In view of these facts, it is not surprising that, on the one hand, certain minor differences are observable, but that, on the other hand, the general features of Table VII are repeated in Table VIII. We are, indeed, almost repeating verbatim our résumé of Table VII when we sum up Table VIII by saying:

(1) With one exception for *B*, one exception for *S* and four for *Wh*, the 24 values indicate an error of expectation.

(2) For all observers the expectation error increases with increase of D.

(3) The mean variations are large, though, as a rule, less than in Table VII.

(4) *Wh* constantly underestimates, *S* constantly overestimates, N.

(5) All of the observers have a lower average value for the estimation of N, *i. e.*, exhibit a more accurate recognition.

The reduction of the mean variations and the increased accuracy of recognition are, we think, due to the simple growth of practice, not to the procedure with knowledge. The increase of expectation in the case of *M* is not easily explained. Possibly the procedure with knowledge engendered some carelessness, but, as will be shown presently, the contrary effect is given by other observers.

Qualitative Results.

The *general effect* of the knowledge of the coming position of V is simply, as reported by *M*, *B* and *S*, to give a feeling of security, to do away with the momentary perplexity or attentive curiosity as to whether V would be easily placed.[1] The attention, toward the end of the interval, can be kept more completely upon the image. There is greater quiet and calmness throughout the test.

Curiously enough, V does not always seem to start from the direction announced. *M* had one instance, *B* three instances and *S* two, in which, after 'higher' had been designated, V started from below or at equality. In all six cases the smallest difference was in use.

A second effect, reported by *M*, *S* and *Wh*, is the presence of an *anticipatory image of V*. *M* had this experience but once: "While my image was going on, I heard also what was to be V. I thought 'well, that 's my imagination,' and tried to attend only to N. Behold the real V matched this secondary image perfectly." *S*, who says she never hears a tone in any test which is not visualized as a spot or line at a definite point in space, and that the procedure with knowledge makes this effect clearer and more intense, very naturally visualizes the expected V, though frequently she also hears it. "In many tests, as soon as the operator says 'plus' or 'minus,' I project two spots, one in the middle for N, one above or below it for V." "During the interval kept going visually from N to a lower place, but heard only N." "This time had both auditory and visual image of the coming V. I anticipate usually in about the same

[1] *Wh*, perhaps because of never feeling this anxiety very keenly, found little difference in this regard.

place."[1] In the case of *Wh* the anticipatory image is far more prominent and largely auditory. "There is a strong tendency to ideate V. I actually hear another tone lower or higher than N. This I usually try to repress in part by attending sharply to the image of N." This sentence is an indication of an interesting effect of the knowledge method. It looks as if, for some observers, the knowledge of the position to be taken by V might be more distracting than helpful. It frees the observer's mind from anxiety as to 'placing' V, but it thrusts upon consciousness an obsession which is still more bothersome. *S* voices this idea when she says: "I think that the expectation of a 'plus' V raised the image of N both visually and auditorily."

Series 3 also gives us further data concerning the *method of decision*. The points brought out are to be ascribed to the influence of continued practice rather than to the method with knowledge itself. In general, each observer's report has become more settled and uniform. There are a larger percentage of tests in which the same method is described. At the same time, the differences between individual observers are more clearly defined. Thus we find that *M* never uses the amount of D as a basis for calculating the time of the reaction, and that, with her, auditory-verbal judgments are very frequent, *e. g.*, "Ah!" "There!" "That's it," "Now," etc., etc. We find that *Wh* has settled down to a single method which is used constantly save when some accidental variation (*e. g.*, the anticipatory image just mentioned) interrupts its course. This method (practically the first main method of this observer in Series 1) is to attend with all diligence to the auditory image throughout the interval. When V begins, the image stands out sharply in contrast, but as V continues the image rapidly dies out, so that when V nears equality, the attention goes over to V and is kept there till the reaction. In the case of *B*, we find that practice has induced more caution; she attends more sharply to the image during the interval (though still to V when it comes) and attempts voluntarily to inhibit premature reactions, especially with a large D. On this account the expectation is largely reduced. Indeed, it disappears with the smallest 'plus' D.

It is of interest to note that, in contrast especially to *M*, *B* never thinks of V as fusing with the image. It could n't "because the image is in the head, the tone outside." "I never thought that the tone could have anything to do with the image." The reaction is entirely automatic: "goes off when

[1] When we also read that in the majority of tests, D is found to be "surprisingly small," we are led to surmise that her anticipated position is too far away from the standard, and that this process may be a source of a constant error in the reactions, though the quantitative results cannot be said to give definite indications of such an influence.

familiarity is reached." *B* is very much bothered by periods of loudness or swelling in V; these are noted, however, only with a descending V. During these periods she is unable to react or to tell anything about the place or movement of V.[1]

S continues to make occasional reactions based upon a bodily glow, significant of familiarity. At other times, there is a "sense of ownership:" That part of V which is like the image is 'mine,' the rest of it is 'foreign.'" There are usually two distinct tendencies to react before the finally successful tendency. These tendencies appear in a sort of rhythmic sequence, and are so related that it would be impossible to react during the interval between them. All this suggests an optimal-time factor. *S* does not, however, make reactions based upon the lapse of time as determined by the size of D. She may, like *Wh*, estimate the size of D erroneously, but usually neglects this estimate if V does not reach equality at the expected time.

Series 4.

Series 4 comprises 36 tests with a time-interval of 10 seconds, the image being eliminated, so far as possible, by distraction set up by odors. This series is, therefore, comparable to Series 1 of this Part and to Series 4 of Part II.[2]

The effects of distraction.

(1) *On the image.* The results of distraction, are, in general, similar to those recorded in Part II, although the continuous change method produces some individual variations not observed before. These variations, which are correlated with the individual variations in the method of decision, are all due, at bottom, to the continual sounding of V. To be more explicit: in Part II distraction was employed with discrete tones; if distraction was complete during the interval, the judgment was usually made without the appearance of the image. In the present series, from six to ten seconds intervene after the cessation of the distraction before the time for the decision arrives. During this period the image may very well assert itself, even if it has been successfully repressed during the time-interval proper. The possibility of this recall has been foreshadowed by our previous citations of cases in which the sounding of V "revived" the image, or caused it to "stand out in contrast."

In Table IX data are supplied showing the outcome of distraction as regards this point of the suppression of the image.

[1] This phenomenon is entirely subjective. *S* had a few such instances with an ascending V. *Wh* was never bothered. The uneven movement in pitch, previously discussed, is quite independent of this intensive variation.

[2] See first article, 455-6, for further details.

As in Table VI, four possible types of distraction are recognized: viz., (*a*), the total disappearance of the image, (*b*), momentary reappearance once (or twice) during the ten seconds without being present thereafter, (*c*), a similar momentary reappearance during the interval with a persistence into V, or another reappearance during V, and (*d*) an appearance at the first sounding of V or during its course. The fifth column gives the sum of the first two columns.

TABLE IX.

The effect of Distraction. (36 cases for each observer.)

Obs.	None	Momentarily in Interval	In Interval and at V	At or after V only	Not at V
M	17	10	4	5	27
B	27	9	0	0	36
S	19	3	2	12	22
Wh	17	5	10	4	22
Total.	80	27	16	21	107

From this Table, in comparison with Table VI of Part II, the tendencies just discussed are easily apparent: thus *Wh*, just as before, attained complete distraction in 17 cases, but, whereas before there were 17 instances of type *b*, and *none* of type *c*, the latter type is now twice as frequent as the former, while type *d* is doubled. Again, observer *S*, although reporting more instances of complete distraction, has twice as many of type *d*. All these cases show clearly this tendency of the auditory image to make its appearance at or during V under the conditions of the continuous change method.

But this tendency may be modified or entirely suppressed in the case of an observer who is not in the habit of using the image as a basis for the reaction. Thus the striking fact, that, for *B*, the image was never present at all during V, is explicable because, in the first place, *B* probably never attends as keenly to the image as do the other observers; and, in the second place, odors readily attract her attention, so that a high degree of distraction is easily produced during the time-interval. This is evinced by the 75% of cases under type *a*. And, finally, *B* does not, as a rule, make use of the image in the decision. Hence when the image is absent at the beginning of V, *B* naturally adopts the method of decision in which the attention is directed entirely to V and the reaction conditioned upon the arousal of some symbol of familiarity.

M exhibits neither the tendency of *S* and *Wh*, nor the contrary one of *B*, but the figures in her case closely correspond to those of Table VI. It should be borne in mind that when

the image reappears, especially during the time-interval, it is present only in the vaguest form and with a very short duration. Thus *M* reports: "Image very faintly, almost unconsciously, present. Felt it was near me without being there." "Half remembered N during interval." A typical case for *B* is: "Complete distraction. Odor bergamot; many associations, stories of bergamot and lavender, old New England people, etc." Her type *b* is thus illustrated: "Image back faintly once near the beginning of the time-interval, but at V had no idea where he was or where the reaction should come." *S*'s prominent type *d* is given as follows: "Faint auditory image appeared half-way through V and was used in reaction." "Image appeared very quickly after V started in response to voluntary effort to haul it up." *Wh* has, as a rule, either complete distraction (which he secures by vigorous attention to the odor, "seeking for its name, encouraging associations, testing its intensity for each nostril, etc.") or distraction of the third type. "Image back a moment at about the seventh second, and also at V so that it served as a standard, though I could not keep it throughout as I wished." These two types are very clear, and are correlated, as will be shown below, with two distinct methods of decision.

(2) *On the identification of N.* Observers *B* and *S*, who had both developed the process of identifying the standard to a high degree, find that the direction of the attention to the odor immediately upon the cessation of N, interferes with this process, and, to a certain extent, renders the entire test more difficult. "I have come now to attend very closely to N when it sounds. I find this necessary with distraction" (*B*). "Distraction makes the experiment harder. Don't have time to place N in my scale" (*S*).

(3) *On the 'placing' of V.* Just as the attention to the odor at the beginning of the interval wrenches the attention from N before it is entirely apperceived, so the attention to the odor at the end of the interval is so well established that V comes as something foreign to the consciousness,[1] a shift which consumes a noticeable time. The gap is estimated by the observers at from a quarter of a second to a second and a half. This gap plays a distinct part in the quantitative results as will appear in Table X. Another and more immediate consequence is that the place of V is often known, not directly, but by the observation of its movement. "V sounded one second before I knew what I was doing." "Have to gather yourself up to attend to V." "Didn't get V's direction till I watched it move" (*M*). "Slight gap between attention to odor and apprehension of tone, but usually place V after that, at once" (*B*). "Takes a short

[1] *Cf.* first article, 455.

time to get adjusted to V which I never recognize immediately." "Took one second to know V was going up and then got it from the movement. Took a long time to forget the smell" (*S*). "Complete distraction. Took one and one-half seconds to know V" (*Wh*).

(4) *On the method of decision.* In our discussion of the effects of distraction upon the image, we have already foreshadowed its effects upon the method of decision. In general, we may say that complete distraction compels those observers who formerly made use of the image to resort to the other chief method, that of attending to V and reacting to familiarity of some sort. Now, since *B* naturally used this method, her introspection may be dismissed herewith, as bringing out nothing essentially new. *M* shows the correlation clearly; with complete distraction she attends to V "until N seems to be sounding again." "Fine distraction; no image; matched where N was." If, on the other hand, the image is clearly present during V, it becomes the object of attention and is used as a standard. There is, too, a sort of intermediate type. "If I have the image at all during the interval, I am half-way ready for V."

Wh, who uniformly used the image whenever possible, presented, as we saw, two main types of distraction, viz: *a* and *c*. His method of decision consequently was of two distinct sorts, much akin to those of *M*, but even more clearly demarcated, as the following instances will show. Type *a*. "Complete distraction, V placed by its own movement; no idea of pitch or place of N, reaction absolute guess-work, touched off by the merest trace of resemblance." "Knew V at once as lower, but had no idea *how much* lower."[1] "Reaction came as a sort of despair." Type *c*: "If the image has been present at any moment during the time-interval, it is more apt to emerge during V. Even if not, it at any rate seems to 'fix' N, so that the reaction is much more easily and confidently made." "Image back a moment about the middle of the interval and also at V, so that it gave a basis for the reaction." Between these two main types there are, as with observer *M*, intermediate varieties which are interesting from the light they throw upon the others; *e. g.*, "Distraction good, though possibly the image was on the verge of reappearance once. Judgment uncertain, but less so than in some. Had general idea (auditory-verbal) 'wide D,' but no concrete idea as to how wide this one was." Here one may

[1] The same report is often given by *B*. These cases are instructive when compared to similar instances in the discrete experiments when V was cognized as absolutely 'high' or 'low,' but not as 'higher' or 'lower' than any standard. Note that there such knowledge sufficed to produce a successful judgment; here it is of no avail in determining a successful reaction, for the *how much* is all important.

suppose that the faint re-establishment of N was sufficient to arouse the general idea "wide D," but not sufficient to relate N and V more definitely. The assurance is likewise of an intermediate grade.

When distraction is complete, *S* often characterizes her reaction as "wild," "vague," "quite in the air," etc. In such cases the reaction is determined by some vague feeling of familiarity: "V stands out visually." But frequently, perhaps in the majority of these cases, *S* has a visual-spatial idea of the place of V in relation to N; *e. g.*, "Image not present at all, but I had a general estimation: let V go about so far,—half way down or to the middle of the screen where N is put."[1] "Reacted to vague idea of place." "Have a vague feeling of the amount of D." Least frequent is a type of decision similar to that of *M*. "Try to see a clue to the image in each 'tone' of V." This is, of course, in contrast to her general method of keeping the image in attention and trying to find something like it in V. Occasionally *S* entirely fails to react, but simply exclaims: "I don't know anything about it."

(5) *On the assurance.* Distraction, like a long time-interval, lessens assurance.[2] This is especially true for observers *M* and *Wh*. *B*, who makes little use of the image generally, is also less certain under distraction. *Wh*. is the more uncertain, the greater the distraction, yet "none of these results are quite as satisfactory as if there was no odor at all to distract." "The image in the continuous change experiments is so useful to me that any weakening of it makes the decision less assured." Very many of the reactions which seem most doubtful to the observer are relatively accurate objectively; in other words, assurance and accuracy do not vary in common. Good reactions are made, not only when the observer pronounces them definitely bad, but also when the observer is "utterly at sea" and knows nothing about the reaction. The explanation of this will appear in a moment.

(6) *On the quantitative results.* In Table X will be found the quantitative results for Series 4. The effects of distraction, as we have already intimated, vary with the observer.

Let us first take the results for observer *B*, who, it will be remembered, was relatively little affected by distraction because her normal method of decision involved attention to V with little or no attempt to relate it definitely with the image. Her results in the present Table are practically identical with those

[1] To make this intelligible, it should be explained that *S* habitually sat with her right ear toward the source of sound, and hence facing the cardboard screen (first article, 417) upon which she projected her visualizations of the tones.

[2] *Cf.* first article, 456.

TABLE X.

10 Seconds Interval, with Distraction.

Obs.	D	V_o III N	m. v.	V_u III N	m. v.	Aver. Limit of Error.	Estimation Value of N.
M	8.4	—0.35	2.24	—2.06	1.37	1.20	—1.20
	11.2	0.64	1.37	—0.37	1.12	0.50	0.14
	14.0	1.29	3.02	—4.28	2.71	2.79	—1.50
B	8.4	1.90	1.23	—1.93	1.85	1.92	—0.02
	11.2	3.53	1.48	—3.33	0.53	3.43	0.10
	14.0	4.48	1.65	—6.41	0.87	5.45	—0.97
S	8.4	—2.44	1.20	5.88	1.76	4.16	1.72
	11.2	—3.36	1.26	3.05	2.01	3.20	—0.16
	14.0	0.53	0.73	0.28	2.69	0.40	0.13
Wh	8.4	—1.88	1.40	2.43	2.27	2.16	0.28
	11.2	0.28	0.92	—0.22	1.76	0.25	0.03
	14.0	0.14	1.06	0.20	2.80	0.17	0.17

of Table VII, save that the size of the expectation error is slightly reduced.[1] This general reduction may be due either (1) to a slight caution, born of practice, or (2) to the slight 'gap,' above mentioned, between the odor consciousness and the tone consciousness.

The results for *S* and *Wh* are likewise correlated directly with what the introspection had indicated as the effects of distraction. Both of these observers felt keenly the loss of the image (*Wh* of the auditory image, *S* of the auditory image and of the opportunity to identify N visually and otherwise), and it is reasonable to suppose that its loss minimized the expectation error, for if there is not in consciousness a certain definite place which V is expected to reach, there is an absence of material for expectation.[2] This factor is, now, supplemented by the influence of the 'gap,' which is of longer duration for *S* and *Wh* than for *B*. Finally, *S* and *Wh*, in their confusion at the loss of the standard, turn to V for some indication of familiarity, and are apt to wait too long in this effort to gain

[1] The reduction was, on the whole, more apparent with a descending variable (just why cannot be stated), so that the estimation value of N has changed its sign with the smallest and the largest D. But this change is insignificant; the values have actually changed but little, and are, all of them, less than one vibration in amount.

[2] It may be objected that *B* ought, on this line of argument, to show no expectation error. But *B* adopted her method of decision quite naturally, whereas *S* and *Wh* in the present series are thrown upon this method which is foreign to their natural procedure. Moreover *B*, as we have explained at some length, is influenced by an habitual-time factor which produces an expectation error.

"some clue to N." Whether these three are the essential or the sole factors involved, the fact that the expectation error is very materially broken up is very patent from the Table. Note especially the reversal of the sign of the error in five out of six cases for *S*, and half the cases for *Wh*, and, more striking yet, the complete reversal of the rule that the average limit of error increases as D increases.

M, as might again be predicted from the introspection, occupies an intermediate position between *B* on the one hand and *S* and *Wh* on the other. There is a single change of sign and the progression of the average limit of error is partially destroyed.

Résumé of Part III.

In Part III we have continued our examination of the problem set forth in the title, giving special attention, however, to the second phase of the question, *i. e.*, to the structural analysis of the consciousness present in the functions of discrimination and recognition.

All the experiments of Part III were made by what we may term the method of reaction or the method of continuous change; its essential feature was the use of a continuously sounding variable which moved from above or from below the standard toward this standard at a uniform rate until arrested by the observer at subjective equality. Four series were conducted: Series 1, ten seconds time-interval, image held; Series 2, 40 seconds interval, image held; Series 3, ten seconds interval, procedure with knowledge, image held; Series 4, ten seconds interval, image lapsing with the aid of artificial distraction.

The quantitative results of these four series are best gleaned from Tables VII to X.

The qualitative results (largely gained from the introspection) are given below in general outline. It should be understood that, owing to the extremely individual character of the treatment of the results (a character which it has been the aim of this thesis to exploit), such a summary is at best merely a very rough outline of the more striking facts which are common to most of the observers. The individual variations which have been discussed at length in the text are, in our opinion, psychologically even more important than any number of generalizations.

(1) Some observers are able to classify and identify the standards in use by auditory-verbal, visual and other associative supplementing. This process is apparently helpful in the reaction.

(2) The variable tone seems to move toward N by stages

which may be regular or irregular. The movement is frequently visualized, and observers have distinct emotional preferences, some for an ascending, some for a descending, tone. The direction of movement is frequently misinterpreted, and illusory movements appear even during the procedure with knowledge.

(3) The method and basis of the decision is distinctly an individual matter; we may, however, distinguish certain types. The attention may be directed (1) upon the image, (2) upon the variable, or (3) alternately upon the image and the variable. (1) When the attention is upon the image, the decision results from the appearance in the variable of a tone (or visual substitute) which 'matches' the image. (2) When the attention is upon the variable, the decision results (*a*) from the appearance of some tone or 'place' in the variable which resembles the standard (whether the image is recalled or not), (*b*) from some subjective change in the intensity, timbre or movement of the variable, or (*c*) from some change felt in the observer's body which is indicative of familiarity. (3) Attention of the alternating type, in so far as it involves a series of auditory comparisons between the image and the variable, is present only in the early tests before the observers attain practice: a form of alternating attention not involving comparison (a single shift from the image to the variable when near equality) is also used by some observers occasionally. Still other decisions are the result of an inference, based upon the size of D, as to the time required to reach equality. Finally, some decisions are not recognitions at all, but mere guesses set off without regard to the actual tonal relations.

(4) The movement of reaction (finger-key) becomes automatic for all observers, though much sooner for some than for others.

(5) After the reaction there is heard a distinct additional movement of the variable which we have termed the 'after-tone;' some observers make use of this to evaluate their reactions.

(6) There is a strong tendency to react too soon; in other words, an error of expectation. This is fostered by several contributory factors, but partially counteracted with varying success by conscious attempts at restraint.

(7) Expectation increases as D increases, save for some observers when under distraction.

(8) No observer can say definitely that a given reaction is exactly correct. Reactions possess merely a varying degree of satisfaction. There is an area, rather than a point, of equality.

(9) Procedure with knowledge of the position of the coming

variable has little effect upon the quantitative results. It merely gives a sense of security to those observers who had occasional difficulty in apprehending at once the position of the variable. On the other hand, there is a tendency to be obsessed by an anticipatory image of the variable,—a tendency which may be a source of some disturbance.

(10) The long time-interval produces irregular quantitative results, owing largely to its deleterious effect upon the image. It is helpful to have the image persist in some form through the interval, so that the amount of D at least may be used as a basis for the reaction; but it is possible to make objectively satisfactory reactions when the image has been permanently lost before the sounding of the variable. Such decisions are usually based upon 'familiarity feels,' and are subjectively quite unsatisfactory to observers accustomed to the use of the image. Difficulties in the apprehension of the position and movement of the variable, which are increased by the long time-interval, confirm a previous assertion that there is a tendency to sharp the image with long times.

(11) Distraction by odors is successful in the majority of instances, though observers using the image in the decision are more apt, with the continuous change method, to have the image in consciousness during the decision. Distraction interferes with the process of identifying the standard, and renders the apprehension of the position of the variable more difficult; there is a distinct gap between the odor consciousness and the tone consciousness. Complete distraction compels all observers to attend to the variable and to react without reference to an image. All observers have less assurance. Those addicted to the use of the image no longer exhibit an expectation error.

(12) Practice lessens the mean variation, and unifies the course of the reaction consciousness of each observer, though, at the same time, individual differences are accentuated.

(13) The method of reaction, since it calls, so to speak, for a 'quantitative' as well as a 'qualitative' discrimination, leads to certain results quite different from those of the tests with discrete tones. Most important is the fact that observers who excelled in the discrimination of discrete tones without the use of the auditory image find the reaction to auditory equality is most satisfactorily accomplished by the keenest attention to the standard and the use of the auditory image as a basis for the reaction.

PART IV.

Miscellaneous tests.

The miscellaneous tests of Part IV deal with points raised during the previous experiments, especially those with discrete stimuli in Parts I and II. Of these tests, those involving the associations of color to tones have already been discussed.[1] There remain to be mentioned the pneumographic tests, the drawings of the movement of continuous tones and the chronometric measurements of the judgment-time.

The *tracings of respiration*, obtained under various conditions by means of a Verdin pneumograph and a continuous-paper kymograph driven noiselessly by a distant water-motor, failed to establish any very instructive correlations. The one obvious result worthy of mention was that shallow and irregular breathing ensued whenever the attention was sharply concentrated,[2] as, for example, in the endeavor to bring back an image clearly just before V, or, better yet, in the reaction-consciousness, where, as we have already pointed out, there was nearly always visible excitement and a high degree of expectant attention.

The *drawings of the movement of the variable tone* used in the continuous-change method were made partly to elucidate the general nature of the subjective movement of the variable, but in particular to see how far the visualizations reported by observer *S* could be objectively recorded. At first, in accordance with the suggestion of Stern,[3] we tried to register these movements by means of the kymograph above mentioned. The observer rested her wrist upon a smooth metal rod fastened horizontally parallel to the plane of the paper. A cardboard screen, in which was cut a narrow slit the length of the width of the paper, was then attached to the apparatus just above the paper: the object of this screen was to allow the observer to trace the movement of the tone with a pen, the point of which was free to move to the right or left along the slit, while at the same time, the tracing was covered up as fast as it was made. A time-marker gave the requisite control. The tests then proceeded in the following manner. When N sounded, *S* touched the paper for a moment to indicate the place (visually and spatially) of the standard; when V sounded, *S* again placed the pen up-

[1] First article, 420; also this *Journal*, X, 1900, 318.

[2] *Cf.* the results lately attained by P. Zoneff and E. Meumann (*Phil. Stud.*, XVIII, 1901, 1-113) who say (p. 44) "Alle diese Angaben . . . . führen zu der Annahme, dass eine willkurliche Concentration der Aufmerksamkeit eine Verlangsamung des Pulses und eine Hemmung der Athmung bewirkt."

[3] *Veränderungsauffassung*, 117.

on the moving paper at the right or left, for a 'plus' or 'minus' D respectively, and then moved her hand in toward the center of the strip just as V seemed to her to move, taking the pen off when she thought V reached the position (auditorily and visually) taken by N. This method of procedure was at first reported to be quite natural and easy, though the movement from right to left was less natural than the opposite one. As the experiments continued, however, objections appeared. To begin with, there was so much for the observer to think about, the starting of the machine, execution of the drawing, making the reaction, etc., that procedure without knowledge of the position of the coming V (always more difficult for *S*) had to be given up. Finally *S* was never satisfied with the resulting curves; the ordinates were not commensurate with the actually experienced tonal 'slumps,' so that the curves represented little but the number and frequency of the 'steps' taken by the tone. Accordingly, at the observer's suggestion, the moving paper device was given up. In its place the following method was adopted. With closed eyes, *S* indicated the place of N, and the starting point and entire movement of V, upon a stationary sheet of paper. The results were entirely adequate representations of the spatial behavior of the tones.

It is rather difficult to describe these drawings briefly. To begin with, N is almost always identified as one of a series of standards, this series consisting of six or seven round, grayish spots. The whole series is not seen at once, but merely the two or three spots in the region of N.[1] But the actual N is not only identified as one of these gray spots; it is always manifested as a horizontal line about three-fourths of an inch long, moving from left to right. The variable starts at a point in space about four inches to the right[2] and four or five inches above or below the place of the standard. When above, it descends vertically, but when below, it rises obliquely to the left. In either case, the movement is such that the gray ball representing V executes a series of curves with the result that, on the side toward *S*, *i. e.*, on the left (naturally the only visible) side, a gray rope is formed, whose outline is an index of the number and nature of the slurs in the movement of V. The actual number is a very uniform function of the time consumed by the tone; each slur representing two seconds, *e. g.*, when D = 14.0 vibs. (ten seconds necessary to reach equality) five slurs would be drawn. Finally it was found, much to the surprise of *S*, that the stop-

[1] We have noted that *S* thought, at first, that there were six or seven, later, three or four standards. Apparently, she finally came to classify correctly into a high, medium and low *region*, only she thought that each region contained several tones.

[2] This distance is more or less arbitrary; occasionally it is shorter.

ping point of the tracing of V (subjective equality) was almost invariably exactly opposite the point at which N had been placed, this giving a most striking confirmation of the vividness and distinctness of the visualizations, and of the readiness with which they might serve in the determination of the reaction.

The recognition-time in immediate judgments. In Parts I and II it was clearly demonstrated that, under the conditions of our experiments (8 vibs. D, with three possible judgments, etc.), the variable stimulus could be recognized as the same as, or as higher or lower than, the standard, in a very brief time after the sounding of the variable; this though the time-interval were 2 or 60 seconds. The introspection bore out this observation, for it was evident that these judgments were made without any process of comparison between the variable stimulus and the image of the standard; they could be made when all trace of the image was removed by suitable distraction during the interval. We termed these judgments *immediate*, meaning that no comparison was present, whether or not there was at the moment any trace of the auditory image in consciousness. That, within the judgments thus classed as immediate, there might be differences in the actual rapidity of the decision has been definitely stated.[1] It now remains to be seen whether these judgments are actually as rapid as the introspective reports indicate, and whether they are fast enough to warrant the conclusion that it would be impossible to have in the consciousness under measurement any process, however fleeting, involving reference to the image.

In order to investigate these points, the following arrangements were made. The air-cock of the blown bottle apparatus was equipped with metal contacts such that a circuit passing by way of a lip-key to a Hipp chronoscope was completed as soon as the air-cock was opened far enough to produce an audible tone from the bottle.[2] Observers *M*, *B* and *Wh* were then practiced in the use of the lip-key and the, at first rather difficult, task of expressing their judgments audibly. Advantage was taken incidentally to secure what we may call the 'speaking-times,' *i. e.*, the time necessary to pronounce the

[1] For example, first article, 443, 3.

[2] It is to be noted that this arrangement is open to a slight error, for, in actual operation, the air-cock is opened suddenly to its full extent so that contact must be made slightly before the current of air has rushed through the four feet or so of tube and set the bottle in action. This, error, however, is very slight, and the form of apparatus used was the most feasible of several that were tried. Moreover, the error, whatever its size may be, lengthens the reaction-time, and hence cannot be construed as contributing to the advantage of the results sought.

judgment words, 'higher,' 'lower,' 'same,' etc.,[1] in response to a single isolated tone, the actual conditions of the experiment thus being in play, with the exception that no standard was given, and that the time measured was, therefore, a single perception-time instead of a recognition-time.

The figures in Table XI represent introspectively valid tests only, those in which the judgments are rated by the observer as correct and immediate. From this Table we wish to make simply the following points, both of which are in complete accord with the introspective evidence already given.

TABLE XI.*

(*Recognition-Times. All results in sigma.*)

Obs.	Cases	D=+8	m. v.	D=0	m. v.	D=−8	m. v.
M	4	657	46	849	37	787	47
	6	407	48	402	49	341	42
B	4	464	99	659	70	609	56
	5	312	63	315	56	384	96
Wh	8	754	101	815	87	709	55
	6	317	36	350	27	294	21

* For each observer the first line represents the recognition-times, the second line the simple reaction.

(1) The recognition of tonal equality or specific difference can be given verbally in about three-quarters of a second. Hence, under the conditions of our tests, judgment is complete before the variable ceases to sound.

(2) Difference and its direction are more quickly recognized than equality.

One is tempted to carry the interpretation of the results still farther, to show, *e. g.*, that the relative speed of judgments of higher and lower in the case of *B* is in accord with her introspective verdict that 'higher' is the easiest and quickest judgment, and that it is to be related to the tendency to pass that judgment.[2] But the cases are very few in number and the mean variations are large. Even after the preliminary practice it was rather curiously difficult to secure a satisfactory series; a half-dozen tests were sometimes necessary to secure a

[1] The observers had strong preferences for the particular word which they used for the judgment, so that it was thought best not to insist upon uniformity in this respect: accordingly *M* used 'higher,' 'equal,' 'lower;' *B* 'high,' 'sa-' (for same), 'low;' while *Wh* used 'higher,' 'equal,' 'lower.'

[2] First article, 450.

single entirely valid result.[1] Of interest, finally, are the times of a few incidental judgments in which the observer was uncertain. The correlation of uncertainty with slow rates is clearly shown for in all these instances the times are over one second.

The chronometric tests, then, give objective verification to our assertion that immediate judgments are made so rapidly as to exclude the possibility of the process of image-comparison.

CHAPTER III.

Conclusions and Theoretical Implications.

To gather together all the principal results of our investigation into brief compass, and, at the same time, to allow each item its proper significance is quite out of the question. Most of the results were obtained under specific conditions, and should not be stated baldly without reference to those conditions. The reader is accordingly referred to those portions of our text in which summaries and conclusions have already been given: most important are,—for the quantitative results, first article, 421, 422, present article, 223-4, 243-4, 250-1; for the qualitative results, first article, 443-6, 448, 455-6, present article, 230, 239, 252-4.

While we keep these specific conclusions in mind, we may venture, however, to discuss the outcome of our investigation, taken as a whole, upon the two problems set forth in the introduction,—the nature of the memory image for tones, and the nature of the consciousness involved in the judgment or decision.

The Nature and Course of the Image.

In regard to the nature and course of the memory image of both clangs and tones, we may conclude that:

(1) The auditory image is but one part of a complex structure which represents the original experience. Put briefly: the memory image of a tone is not a tonal memory image; it is that and much more. A tone is held in memory not only as an auditory quality, but also as a definite quality, possessing marks which help to identify it. These marks of identifica-

[1] Some of the difficulties are indicated by the following quotations: "Possibly opened lips too soon." "Said 'same' instead of 'equal.'" "Hesitated slightly for word." "Completely rattled: too anxious to make a quick decision." "Opened lips before I said the word." "Tendency to say 'equal,' then said 'higher.'" "Slow judgment." "Not sure of judgment." "'Equal' judgments naturally need the verbal expression to 'cap' them, but 'higher' and 'lower' I know before I can speak the word. Not natural for me to put the verbal sign on till later."

tion are supplementary contributions from various modalities,—visual, temperature and strain sensations, associations of various sorts, affective reactions, etc. The relative importance of these various features varies with the individual observer, and the conditions under which he is placed.

(2) The auditory image proper, usually of the timbre of the stimulus and localized at the instrument, attains its maximal excellence about two seconds after the stimulus; thence, despite the active use of memorial aids such as visualization, contraction of throat muscles, etc., it gradually wanes, suffering most in intensity, less in clearness, least in quality. It is in a very unsatisfactory condition at 40 seconds, and often entirely gone at 60 seconds.

(3) The image apparently *tends* to flat, but this tendency is more or less consciously resisted by most observers, so that, at least at 30 seconds or afterwards, it is more often sharp.

(4) The other constituents of the memory image do not necessarily follow the course of the auditory core; they may be serviceable for purposes of discrimination when the auditory image has disappeared entirely. This independence of the supplementary features of the memory image complex is best shown in the course of the memory image during long time-intervals. We have frequently mentioned the disappearance of the auditory core or its arbitrary alteration under these conditions.

(5) Continued practice with a stimulus of a particular clang color (tonometer or bottle) increases the serviceability of the image: it becomes more intense, clearer and of longer duration.

(6) The task of actively holding the image very soon develops a habit of imaging; the image, that is, of itself becomes insistent, and so insistent that, when exclusion of the image is desired, very active attention to naturally powerful distractors is necessary completely to repress it for relatively short intervals (10 seconds). Yet the ease with which distractors overpower the image is largely dependent upon the mental constitution of the individual: observers who make little use of the auditory image in the decision, observers who are not auditory-minded, and observers naturally attracted to odors, are able to repress the image with relative ease.

The Process of Judgment.

In turning to our second problem, the analysis of the judgment consciousness, let us note (1) that the method of right and wrong cases which we employed in the earlier tests really yields results obtained under two quite dissimilar conditions, viz.: (*a*) when $D = 0$, and (*b*) when $D = \pm 8$. However the quantitative results are treated, one must differentiate qualita-

tively between judgments of identity and judgments of difference, and, again, between simple judgments of difference without direction, and definite judgments of a difference and its direction.[1]

We must further note (2) that the values yielded by the reaction method, on account of the peculiar conditions which we have attempted to analyze, cannot be compared off-hand with those obtained by right and wrong cases. We cannot even say that the determination of subjective equality in the former method is akin to the judgment of equality in the latter. Yet, despite these radical differences, both methods furnish us with data which admit of unification in generalizations as to the mechanism of judgment.[2]

The following conclusions summarize the evidence we have obtained in regard to the structure of the judgment consciousness.

(1) The presence of the auditory image is not necessary to the recognition of either difference or equality. Judgments without the slightest trace of comparison were so frequent as to be the prevailing type for most observers. Their existence is attested by the introspection of the observers, by the tests made under distraction and by the chronometric measurement of recognition-times.

(2) The auditory image may be present in the judgment consciousness, but not itself an object of attention, not serving as a basis for comparison.

(*a*) This is most common in judgments of identity, when, although the recognition is immediate, the variable tone seems to re-enforce, or flow into, the image. Two interesting questions arise here: is the presence of such an image useful? Again, is it possible that its absence is the cause of the rapid

[1] It is clear that this division disregards the distinction between right and wrong cases: judgments of difference might be given with objective equality, etc. But the errors have already been discussed; for present purposes our immediate object is to deal with the right cases only.

[2] It may possibly be objected that the term 'judgment' cannot properly be applied to the reactions of the continuous change method or to the flash-like immediate answers in the case of discrete tones, on account of their simplicity and semi-automatic nature. J. Royce (*Psych. Rev.*, IX, 1902) seems to imply that Marbe's experiments (*Experimentell-psychologische Untersuchungen über das Urteil*, Leipzig, 1901) are open to this objection, for, after stating that Marbe undertook to investigate the psychology of the judgment, he says (115): "therefore it was the experimenter and not the subject in whom the process that was to be studied went on." We must, however, remember that mind is full of short cuts, that mental processes follow psychological courses rather than logical patterns. The experimentalist must work at first upon the analysis of comparatively simple bits of content; *cf.* our recommendation below, p. 268.

decline of right cases for D = o, as time-interval increases? The fact of this decline is clearly established: it was found by Angell and Harwood and by Wolfe. That long time-intervals seriously affect the auditory image is equally definitely made out. Let us, then, consider this question first.

One must bear in mind that long time-intervals affect the image in several different ways; its pitch, its clearness and its intensity, all are influenced. Now, though we have just stated that the image suffers least in pitch, it is, nevertheless, evident that a slight change just here would be most disastrous to the successful execution of *qualitative* discrimination. We have, as a matter of fact, been several times forced to take cognizance of the tendency to sharp the image, and we have shown definitely[1] that this tendency, as manifested by the error of judging — instead of = (and possibly, also, that of = instead of +, though the conditions are there rather different), is markedly increased by long time-intervals. In other words, the effect of time-interval upon right cases is largely due to the sharping of the memory image (including both auditory and supplementary components) rather than to its absence. Further discussion of this point would, therefore, lead us into the matter of judgments of higher and lower, and this we must defer to a later point.

The first question still remains:—is the auditory image which is merely present and not the object of attention, at all useful in those judgments of equality which are *correct?* We are of the opinion that, on account of its not being a direct object of attention, the image in these cases forms simply one feature in the 'familiarity feel,' which, as we shall try to show in a moment, is, in part, characterized by the ready provocability of centrally excited sensations. If the particular pitch which is recognized happens, when V sounds, to be actually in process of central excitation in the form of an auditory image of the standard, then the recognition is, in all probability, aided by this fact. The ease of the reception of the variable stimulus is distinctly enhanced, and the variable is then, for the observer, recognized as the *same tone* as N, rather than as merely familiar.

(*b*) In judgments of difference, likewise, the image may be present when the variable sounds, but it is then almost invariably thrust out of consciousness by the direction of the attention to the variable, and the judgment is determined for the most part by other factors. The advantage of the persistence of the image into the beginning only of the variable, in the reaction method, constitutes a special case. The image is not then present in the judgment proper; it is merely an accessory

[1] First article, 422, 2 (*b*).

to a preliminary judgment of the position of the variable at the start. Here it seems to aid some observers who react in terms of elapsed time, to make a more definite notion of the amount of D.

(3) The auditory image may be an essential component of the judgment consciousness, becoming a direct object of the attention, after the attention has once been given to the variable. Such judgments exhibit a true process of comparison.

(*a*) When working with discrete tones, judgments by comparison appear in cases of difficulty, when the conditions are novel, when the variable fails to touch off the decision at once, when two contradictory impulses are felt. In short, the deliberate use of the image as a standard of comparison is a more complicated device, a round-about path, indicative of obstacles, uncertainty and hesitancy. Its results, moreover, are themselves uncertain and quite as likely to be wrong as right.

(*b*) When working with continuously changing tones, the auditory image may be, even for observers who entirely neglected it with discrete tones, the object of constant attention, the standard to which the variable is compared,—whether by a series of rapid alternations of attention, or by active attention to the image (the variable itself being, since peripherally excited, sufficiently insistent without attention). This apparent change in the function of the image is but apparent. The conditions of the reaction method demand an exact identification of the variable and the standard, not a simple choice of one out of two or three possible answers. We have frequently shown that the reaction was felt to be merely an approximation, and that there was never absolute certainty. Now all this is tantamount to saying that the reaction calls for a very careful discrimination. This is more difficult, and hence it is not surprising that some observers make the fullest use of the memorial representation of the standard.

We have already mentioned, also, that, in many cases, the auditory image received attention up to the time the variable sounded in order to get a more exact determination of the amount of D, and hence to furnish indirectly a basis for the execution of a reaction at the expiration of a definite time-period.

We must now consider cases (1) and (2), especially the former, more fully, and seek to show what replaces the auditory image as the basis of judgment. Two main types must be explained, viz.: positive judgments of 'higher' and 'lower,' and judgments of identity. We may then discuss, finally, judgments of difference only, which may or may not involve the image.

4. Judgments of 'higher' and 'lower,' made without conscious reference to the image, are largely analyzable into com-

plexes of strain sensations, with less prominent visual and organic elements, set free neurologically by the variable stimulus. The two chief factors, feelings of tightening and relaxation for 'higher' and 'lower' respectively, were reported throughout the tests with discrete tones, and were also well brought out with the wide differences used in the reaction method. We believe that these strains, which are especially noticeable in the chest, throat, eyebrows, scalp, and about the ears, are explicable as symbols for 'upness' and 'downness' in the tonal continuum, set up by every-day experience, especially in executing and listening to music. Of course, it is impossible actually to differentiate innervations of the vocal cords within the small limits of tonal differences employed (the maximum D with discrete tones being less than $\frac{1}{8}$ of a whole tone), yet the variable stimulus may arouse a complex of sensations,—partly centrally, partly peripherally excited,—which means simply '*high*' or '*low*.'

For certain observers who are extremely visually minded, the visual features set up by the stimuli may play a more important part than the strain sensations. The actual muscles concerned in mediating the strain sensations are also quite different for the different observers, but the general fact exemplified throughout is that judgments of 'higher' and 'lower' are usually mediated by the associated or supplementary components of the consciousness set up by the variable. Strain sensations seem to be, *par excellence*, the symbols of rise and fall in the tonal continuum.

The reasonableness of this explanation is, we think, attested very definitely by occasional instances in which imagery more specifically associated with the tonal scale was the deciding element in the judgment. The instances referred to are visualizations of a printed musical scale, of a piano key-board, the kinaesthetic imagery of striking one piano note a half tone above another, etc.

(5) Judgments of equality or identity without the presence and use of the auditory image are, as we have said, not so frequent as judgments of difference. When working with discrete tones, V is apt to bring up the image of N, though equality may be immediately recognized without comparison. We have intimated that in these cases the image simply became one part of the familiarity feel. We have now to consider more fully the nature of this feel, and to take into account, especially, judgments of equality in which the auditory image is entirely absent, (*e. g.*, with long intervals and distraction in the case of discrete tones, and with both these and the cases of observers who attend to V, in the reaction method).

Both of these types of judgment present clearly the problem of the *familiarity feel*, since in both types, there is absence of

any image and of the process of comparison. What is the structure, then, of the familiarity feel? Most pertinent in this connection are the continuous change experiments, for every reaction is an indication of equality. Discarding all tests in which an image of N was present, we find that the remainder may be placed in two groups, according as to whether familiarity was based (*a*) upon some subjective indication in the variable tone itself, or (*b*) upon some general indication afforded by the observer's own body.

The indications of the first type are exemplified by the following phrases culled from the introspection: the variable at equality is said to be,—graspable, appealing, more noticeable, louder, stronger, lingering along, standing out, a warmer gray, rounded-up visually, splayed out, etc. It is evident that many of these modifications of the variable refer to other than auditory features; thus, the first is tactual, the last four obviously visual. We are again reminded of the prominence of the associated and supplementary components of the auditory experience which were in evidence in judgments of 'higher' and 'lower.' It may be supposed, then, that the standard arouses a more or less definite complex of sensations, and that when the variable stimulus arouses the same, or a closely similar, content, the identification is affected. In other words, that point of the variable stimulus is familiar which has a peculiar effectiveness for the arousal of centrally excited sensations.[1] Such phrases as 'appealing' and 'my tone' indicate very obviously that the identified tonal quality is, if one may use the the term, peculiarly 'apperceptible.'

The indications in the second type are much less varied in nature and much less frequent in occurrence. Typical experiences are given in the phrases:—"glow of warmth," "kind of jumped all over," "felt a sense of ownership." These experiences seem always tinged with more or less pleasantness. They remind us of the pleasant "mood of feeling at home" which has often been attributed to the recognitory consciousness.[2] It is to

[1] *Cf.* Külpe, *Outlines of Psych.* New York, 1895, 172; Titchener, *An Outline of Psych.*, New York, 1899, 274.

[2] *E. g.*, Külpe, *op. cit.*, 172 ff; Titchener, *op. cit.*, 274 ff. The term 'mood' is, we think, rather objectionable as it connotes, to use the latter author's terms (241), "the weaker emotive states which persist for some time together." The affective reaction present in our recognitions may be very short-lived. On the other hand the term 'mood' has the distinct advantage of indicating the origin of the feeling of familiarity, since it refers us to an emotion as the primary source, and thus gives a biological explanation for the experience. There should be something in our terminology to indicate the distinction between such 'weakened' and 'degenerated' feelings and other feelings which are not the products of this line of development. Possibly the term 'secondary feelings,' on the analogy of the secondary reflexes, might serve to distinguish

be noted that, in common with the familiarity marks of the first type, these indications are components of the associative fringe which gathers about the auditory core and serves to give it individuality and identity. On the other hand, these components must be different in origin. The changes felt in the tone serve to identify that particular experience. But the general bodily reaction stands for familiarity in general; the variable is not the-same-as-N, but simply familiar. Such a reaction might identify as familiar, experiences quite other than those with which we have been concerned. Indeed, one would be very much more likely to experience the 'glow' of familiarity in situations in which the content of the experience had more complexity, more interest and vital importance than can be instilled into laboratory tests in the recognition of pitches.

Finally, recognitions of familiarity were not, at times, analyzable to the extent just described. The first thing to appear may be merely some auditory-verbal reaction,—perhaps the words 'equal' or 'same,' or, in the reaction method, the phrases 'that 's it,' 'now 's the time,' etc. In these cases we think the explanation is simple. The relatively complex content which marks more definite identification is replaced by merely the word content, 'known.' In all probability, even such recognitions are not made indifferently. We may suppose that the feeling of 'at-homeness' is also weakly present. The conditions of experimentation, however, lead the observer's attention to the verbal formulation, and the other features escape notice in that particular judgment. We have already called attention to the one-sidedness of individual bits of introspection. If we admit, then, that the cases under consideration exhibit both the auditory-verbal 'known' and a weak feeling of ease, we have shown enough to explain the execution of the judgment. A good analogy, which shows how the auditory-verbal consciousness may represent what was once more complex, is to be found in the development of cutaneous local signature, where the marks of locality, once, in every probability, made up of a complex of pressure-strain-articular-muscular sensations, became visual, and, ultimately, auditory-verbal.

Now the familiarity mark is quite as difficult of analysis as the locality mark, so that when we have procured, as in the present study, several thousand introspective analyses, we are warranted in assuming that the evidence of the majority of the cases, taken together, is most illuminative, and that, in the light of this evidence, those cases in which introspection fails to discover all the customary marks of familiarity, and, too,

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these from the others which might then be termed the 'primary feelings.'

those cases in which introspection fails to reveal any trace of the mechanism whatever (*i. e.*, in which the tones is simply familiar, and that is all), that these cases are not to be mistaken as evidence for the unanalyzability of the familiarity feel, but rather of the limitations of the particular bits of introspection involved. We are not compelled to assume an unanalyzable 'quality of knownness' (Höffding), or an irreducible attribute of centrally excited sensations (Washburn).

(6) Judgments of difference in which the direction of the difference is unknown are quite common for some observers. They rarely appear except when there is an actual objective difference.

To explain them it must first be noted that they are of different types. We may distinguish at least three.

(*a*) Those involving the process of comparison and the use of the auditory image. This type is found in the case of observers who make most use of comparison (*e. g.*, *W*). The attention alternates several times between the two images,— that of N and that of V,— until the identity of the two becomes confused, so that the observer knows that one is higher, but cannot tell whether it is the image of N or of V.

(*b*) Those in which there is no comparison and no use of the image. Judgment results from a 'motor' or visual 'shift' set up by V, only this reaction is not definite like that symbolic of 'high' or 'low;' it simply indicates a change or difference. The possibility that a stimulus can reproduce the judgment of difference without producing a more definite judgment of the direction of the difference has been frequently stated. The explanation given by Külpe[1] and by Stern[2] seems quite adequate in the present connection. Finally, we may distinguish a third type.

(*c*) Those in which judgment does not stop at the assertion of difference as in (*b*), but in which the direction of the difference is afterwards successfully ascertained by voluntarily "hauling up" the image of N and performing the process of comparison.

This completes our problem. We have endeavored to present an exhaustive analytical investigation, with the aid of two distinct experimental methods, of the mental processes involved in the discrimination of simple tones and clangs as conditioned by time-interval and by the mental constitution of the observer. We have endeavored finally to express in as compact a manner as possible the generalizations of the facts

[1] *Op. cit.*, 173 f.
[2] *Veränderungsauffassung*, 251.

adduced and the theoretical significance of these generalizations.

Certain problems have appeared in the course of the investigation which might well receive further discussion and further investigation. We have, for example, been impressed with the prominence of the spatial characteristics of tones. While we cannot here amplify the proposition, we may assert that, in the light of our introspective evidence, there is nothing immanently or innately spatial about tones; that all their spatial characteristics are secondary and supplementary, the product of experience with very special emphasis upon the spatial characteristics of the source of the sound.

Another problem which would be suitable for experimental investigation, and closely related to our own subject is to be found in the recognition and discrimination of auditory qualities whose pitch (at least that of the standard) is not that of a single isolated note, but that of a cadence or melody, or of a chord. Such a content would present conditions more nearly resembling those of actual life. The mechanism of recognition might conceivably be more complex, but at the same time more open to view. The influence of absolute pitch, of musical training, of the nature of the imagery, would all be more apparent than in the case of isolated tones. From the writer's own experience it seems probable, also, that such tests might be made with time-intervals greater than those here employed.[1] The point of attack must be throughout qualitative (though fidelity of memory, or, to speak more strictly, capacity of recognition, might be incidentally determined), and great attention must be paid to the peculiarities of individual observers.

[1] *Cf.* Stern, *Veränderungsauffassung*, 206, "Für einen einzelnen Ton ist die Reproducierbarkeit zeitlich eine viel beschränktere, als für den Klang einer Stimme oder für eine Melodie."

THE PSYCHOLOGY OF MENTAL ARRANGEMENT.

By I. MADISON BENTLEY.

Mind is framed on a definite and intelligible plan. Its design is apparent, not to the psychologist, alone, but to any one who is accustomed to reflect on the nature of mental experience. Even if it were possible to overlook the regularity and the uniformity of one's own conscious processes, there would remain, in the orderly arrangement of the objects of knowledge, a sufficient objective guaranty for the orderliness of mind itself. But, although an orderly world implies an orderly consciousness, it must not be assumed, forthwith, that the two orders are identical; that one type of arrangement is common to physical and mental existences. Such an assumption is as premature as is the inference from the nature of physical elements to the nature of mental elements, as set forth in the various 'copy' theories of mind. The actual type of arrangement—within mind, no less than without it—must be determined empirically. Now, the problem of mental arrangement involves such an empirical inquiry into the nature of mental connections. Its solution means the setting forth of all the typical patterns or modes of arrangement into which mental processes fall. This is no depreciation of the worth of analysis. No one can deny that an accurate inventory of things mental is an extremely important part of the psychologist's account of mind; but such an inventory does not properly complete the account. The psychologist must, also, explain just how one mental element fits into another, how part-processes are set into groups and how a well-ordered consciousness differs from a mere collection of sensations, ideas and feelings. Arrangement is no less essential to mind than is the mere existence of elementary structures. And but little reflection is needed to convince one that analysis—no matter how searching and thorough—cannot set forth the entire plan of mind. Even when analysis has reached the last irreducible bits of consciousness, the task of reversing the process still remains. One has yet to discover what has actually been done to consciousness in the process of abstraction and, also, what must be done to consciousness to restore the abstracted elements to the tissue of mind. That is to say, mind must be described in synthetic as well as analytic terms.

Until analysis had been carried to the extreme histological limits which refined methods have made possible, it was customary to solve the problem before us either in terms of association or of intellection; to have recourse either to a "gentle force," as Hume puts it, which brings ideas to mind, one after another, or to an active mental principle which sets in orderly arrangement the materials of sense. But the venue of the case has been changed several times since the days of the associationists and the intellectualists. Instead of seeking to lay a basis for knowledge, by enumerating the likenesses and differences among the objects of ideas, the psychologist sets aside the problem of knowledge and inquires directly into the modes of connection obtaining between mental processes themselves. Furthermore, he pushes the question beyond the train of ideas and seeks to make out the connections among simpler and simpler compounds, until he comes upon the very last terms of analysis and the relations that obtain between these in mental structure. It must also be noticed that this change of procedure has involved a change of emphasis. Attention has been directed from the powers and forces which were formerly thought to furnish the mainspring of mental activity to an empirical analysis of the actual contents of the individual mind. New elements, new arrangements, new modes of combination, have thus been brought to light.

The problem before us is one of the results of the developed analytical method. Given a number of mental elements entering into a group, can one, it asks, regard the group as, in any sense, a bare product or must a unique kind of element, as element furnished by the mind itself, be added as an essential feature of the group? Is the 'fourness' in the perception of four objects or the 'squareness' of the square, itself, an element? It is clear that the question raised is a fundamental one—one that is of vital importance to the psychological system. It is important—I scarcely need to say—because it raises the whole question of the scope and validity of analysis and of the adequacy of the type of description which limits itself to 'elemental' terms. It is the test of analysis by synthesis.

To appreciate all that the issue involves, it will first be necessary to have some notion of what the possibilities of mental arrangement are. In the first place, it is conceivable that a perception or an emotion should be made on an architectural pattern, with sensations for bricks and stones and feelings for mortar. Or the procedure may be supposed to be even simpler than that. It may be like fitting ground and polished stone into ground and polished stone, as in the foundation of a Greek temple;—a simple adhesion so firm and so close that the weight of the race's centuries makes the parts one and obliterates the

lines of junction. The architectural figure may, however, be quite wrongly applied. It is possible that mental synthesis is more like the mathematical process of summation, of adding unit to unit; or, perhaps, it is a matter of grinding-up part-processes for the manufacture of new wholes. Again, there may be a communistic participation among mental contents whereby each shares in the product of all; or, finally, mind may stand apart and spin the texture of consciousness from the raw threads of the senses.

Certain of these hypotheses, one is inclined to dismiss at once. But the very fact that the problem can be stated in so many different ways warns us that we must not beg the question at the outset by assuming the truth of any single set of terms. We shall best reach the heart of the problem, even though the procedure be somewhat slow, by tracing back the several arterial channels as they spread themselves through the literature. In fact, the first object of the present paper is to bring together the various recent contributions to the subject. These contributions have been made, for the most part, by the Austrian school of psychologists. In the current English literature, they have not received the attention that their importance seems to warrant. I shall, for this reason, give them as complete a review as my space will permit.

There is, however, one preliminary question in method which must be raised before we begin our historical section. I shall not attempt to answer it now for it will recur presently. It is this: what is the nature of analysis? It will be sufficient, for the present, to recall that there are two general types of analysis. These two types we may, for convenience sake, call the external and internal types. External analysis simplifies a mental complex by simplifying its conditions. If one wants to become acquainted with the elements of a musical note, one may sound, in turn, tuning forks (let us say) corresponding to the several parts or partials of which the note is composed. This is, of course, one of the chief functions of experiment; the simplification of an event through the simplification of its conditioning factors. On the other hand, the same note may be analyzed internally by sounding the note and then turning the attention hither and thither to 'hear out' the partials which make the simple clang. The latter type of analysis may, indeed, first reveal itself in an immediate apprehension of the whole as made up of a plurality of parts (*cf.* Stumpf's definition of analysis). Both kinds of analysis are justified in psychological procedure by their results. The great difference in the results is this: the one tears a member from its fellows, wrenches it from its setting and places it in comparative isolation; the other either subordinates a part to the whole or it

clarifies a part—makes it stand out from the whole—but does not destroy its organic connections. The part 'heard out' or 'seen out' or 'tasted out' is always heard or seen or tasted on a background which stands up close against it and, at the same time, sets it in relief.

It is extremely fortunate for psychology that both these methods are at hand. The experimentalist, when he is charged (usually by the sentimentalist) with lacerating mind in his vivisection, has but to turn to his alternative method and justify his account. By examining the members of a complex, now in connection and now out of connection, he comes to see exactly what the connection means and in how far it alters his elements.

We may pass now to the concrete discussions of our specific problem.

The first man to take up the question for its own sake and to treat it systematically was Chr. v. Ehrenfels, now Professor of Philosophy at Prague. Ehrenfels[1] was attracted to the question, first of all, by E. Mach's work on the *Analysis of the Sensations* (1886). Mach had said that when we listen to a melody or look at such an object as a tree, we *sense* the melody or the tree immediately, as a whole; *i. e.*, we have sensations of spatial form and of tonal form.

To understand clearly what Mach means by a sensation of space-form or of melody, it is necessary to recall his peculiar use of the term 'sensation.' "The world," he says (*Analysis of Sensations*, trans., p. 10), "consists only of our sensations;" and again, "we have knowledge *only* of sensations." That is to say, the sensation is not simply a mental process, but a bit of knowledge. It is, moreover, distinguished from intellect by being an *immediate* bit of knowledge; what we see, hear, or handle, and not what is worked out by the understanding. These sensations, Mach analyzes in a twofold way: as mental fact or as physical fact, according to the point of view from which he regards them. Sensations are, then, the elements that make up the world. To search them out, one has only to analyze the world. The sight of a tree involves color-sensations and space-sensations. Color and form can be varied independently; changing the color does not necessitate change in form, and *vice versa*. So with a melody. Though the tonal sensations (pitches) differ, one can still have the same melody (as a tune set in different keys). This melodic form, then, which is independent of absolute pitch, is apprehended imme-

[1] *Vierteljahrsschrift für wissenschaftliche Philosophie*, Vol. XIV (1890), p. 249.

diately and is, therefore, a sensation—a time-sensation, an ultimate element in experience,—one which must, moreover, depend upon a particular system of neural processes.

This is the point at which Ehrenfels takes up the investigation. What now, he asks, first of all, are these space-forms and time-forms of Mach's? Are they simply combinations of elements or do they introduce something new; something not contained in the elements? Mach, he thinks, is not clear on this point. He proposes to work it out.

Ehrenfels puts the problem in this way: Suppose that there stands in consciousness a group of n tones forming a melody, each tone having its definite place in the series; the question arises, 'is there in the apprehension of the melody, anything more than the n individual tones taken together?' Or 'is there more in a space form than the n determinations of position?' Such a question cannot be decided by simple introspection. It is too subtle and too delicate. One must proceed, therefore, more objectively.

The presumption against a new element rests, says Ehrenfels, upon an unwarranted extension of the concept of conservation. But the principle of conservation does not apply to mind as it applies to matter. The combination of material elements is one thing; the synthesis of mental elements quite another. But if conservation does not stand in the way of new synthetic elements, neither does the principle of psychophysical parallelism. For it may well be just the physical correlate of the individual consciousness that furnishes the substrate for a new element. The very physiological condition (whatever it may be) that makes all the tones of a melody appear in a single individual's experience is sufficient to satisfy the parallelist's objections to a new element.

These theoretical difficulties settled, Ehrenfels proceeds to develop still further Mach's idea of formal elements. He proposes, as a general term, the words 'form quality' (*Gestaltqualität*). The proof for the existence of form qualities or qualities of form lies, as Mach indicated, in the similarity of groups which are made up of entirely different elements. Mach's melodies and spatial figures are good examples. Here is the argument as put forth by Ehrenfels. Complexes which are nothing but sums of elements must be more similar the greater the similarity of their several elements. But a melody in different keys—*i. e.*, with all its tones different—is more like itself than it is like another tonal sequence built upon the same elements. And the likeness is apprehended immediately, without reflection (*i. e.*, it is Mach's sensation). If one objects that the melody lies in the constant transition from tone to tone (in different keys), the term 'transition' brings in something which is more than

a sum. It is just another word for 'tonal form.' And the same is true of spatial forms. Any figure is more than a sum of positions. Ehrenfels defines form qualities, accordingly, as positive ideational contents, appearing in consciousness with such ideational complexes as are composed of separable elements. Any ideational complex which is necessary for the appearance of a form quality is called the *ground* or *basis* (*Grundlage*) of the form quality.

It is not surprising to find that Ehrenfels's broad definition yields a host of combinational qualities. All of these, the author places in one of two general classes. They fall either into the 'non-temporal' or the 'temporal' class, according as their elements are all apprehended in a single perception or require images of memory and expectation. A picture, *e. g.*, which is apprehended at a glance, involves a non-temporal form quality, while a melody or a gradually changing color is grasped as a unitary whole only by the co-operation of perceptual and memorial factors and includes, therefore, a quality of the second class.

Form qualities are, by no means, limited to Mach's tonal and spatial forms. Perception is full of them. First of all, the various determinations of visual and tactual space-perception, including the perception of movement, give a large number. Audition yields, besides the temporal form qualities of melody, the non-temporal qualities of harmony and clang color. To these are to be added color harmonies, fusions of pressure and temperature (as in the perception of liquidity) and of pressure, smell and taste. Moreover, any change in any definite direction, as rise in scale, reddening, cooling, blanching, growing blue, can be apprehended as a unitary and independent thing and, hence, becomes a form quality.

According to the definition, relations come under the same heading. But they differ from the qualities that we have been considering. A melody or a square is not simply a sum of likenesses and differences (comparison-relations). A melody is heard, a square seen, but likeness and difference are not seen and heard. And, in the second place, relations involve an activity of the subject, *i. e.*, *comparing*. This activity consists in shifting the attention from one of the related things to another. It is a change and, like every other change, can form the ground for a temporal form quality.

Similarly, the incompatibility of two mutually exclusive ideas (as of a thing that is both round and square) is an ideational element which forms the basis for the negative judgment —the judgment of incompatibility, contradiction. This is to be considered as another instance of form quality.

Thus far, we have spoken only of form qualities which involve relatively simple groups of elements—perceptions and relations;

groups, we may say, of the first order. Ehrenfels does not, however, stop with these but proceeds to indicate still another class of form-elements; namely, "form qualities of higher order," qualities which are themselves built up out of simpler form qualities.

These structures of higher order arise in two ways; (1) by the comparison of the simple form qualities that we have discussed; *e. g.*, by a comparison of melody with melody or of movement with movement, and (2) by the simple combination of qualities of the first order; *e. g.*, by the union of two or more melodies in a polyphonic composition. Thus we see that form qualities of a higher order are composed, as are those of lower order, by a comparing, 'relating' activity or by a more passive combination of simpler structures.

But this twofold origin of form qualities leads to a difficulty. It introduces the very troublesome concept of mental activity. Ehrenfels takes account of the difficulty by raising the question: in how far does the form quality arise directly from the elements and in how far does it involve a special activity of the intelligence? Mach was explicit on this point. The melody or the space, he said, is just 'there.' It is immediately sensed when the tones or visual qualities are given. There is no question of a special synthetizing activity. Ehrenfels's answer to the question is substantially the same as Mach's. One is, he admits, often conscious of tension, exertion, in apprehending forms and melodies, but this apparent activity in the creation of a form quality is really directed toward collecting the elements into a group. For example, the effort one feels in "taking in" a picture or a melody, as a whole, is expended in bringing together the colors or the tonal elements and not in the construction of the form quality itself. If there were, Ehrenfels argues, a specific activity connected with the form quality, it would surely thrust itself upon attention, since these unique contents play so prominent a part in consciousness. But of such an activity we have no direct knowledge, and the inference is that it does not exist. Even the class of form qualities known as relations involve, only indirectly, mental activity. The "comparing activity" is but the shifting of the focus of attention from one of the related elements (*Fundamente*) to the other. It is concerned, therefore, with bringing together the materials for the form qualities and not with the creation of these qualities themselves. The relation of the "creative activity of the imagination" to form qualities is not so successfully set forth by our author. He seems, however, to intend, even here, that any special activity shall be directed, as before, to the *Grundlage* and not to the new qualities produced; but, unfortunately, he neglects to describe the processes through which this crea-

tive activity operates. One may say, further, by way of criticism, that this particular part of Ehrenfels's discussion is of little value because it contains no adequate analysis of the concept of activity. His general results are, however, important for analytic psychology. In a very great variety of mental complexes,[1] over and above the elements into which the complex falls, there remains, he insists, a mental factor which is a necessary and characteristic feature of the complex;—something which may remain unchanged even though all the elements be altered. This new factor, this 'positive ideational content' is the "form quality."

The position which Ehrenfels takes will best be criticised after its other representatives have been considered. One point in his argument may, however, detain us a moment. It concerns his proof for the existence of form qualities. The proof lies, as we have seen, in the possible substitution of elements without change of form, and it rests upon the 'axiomatic' proposition[2] that 'sums are more alike the more alike their elements.' This statement is, as it stands, not entirely free from criticism. The word 'sum' has a strong mathematical connotation; but, as it is used by Ehrenfels, it refers plainly enough to the combination of qualitative units. If the 'axiom' be taken in a purely quantitative way, it will not stand without modification. For two numbers, exactly alike, may be the sums of quite different terms;[3] *e. g.*, $9+8=1+16=17$. That is to say, two like magnitudes may be considered as the sums of very different part-magnitudes. The statement is true, however, so far as it is taken to mean that as much can be got out of a sum as is put into it; so far, *i. e.*, as summating is just piling up like units without regard to qualitative differences. But when the term 'sum' is transferred to qualities, the axiomatic nature of the proposition cited becomes more dubious. Now mathematical formulation becomes inadequate and one is obliged to resort to description. Description becomes necessary, apparently, because qualities can combine in different ways and because the mode of combination is very apt to affect the product. We see this continually in physical science. One and the same element or group of elements has allotropic forms, substances with widely differing characteristics; *e. g.*, graphite and diamond or calcite and aragonite. And, again, organisms

[1] "Gestaltqualitäten enthalten somit die meisten Begriffe, mit denen wir operiren" (page 282).

[2] "Man kann nämlich von vorne herein behaupten, dass verschiedene Complexe von Elementen, wenn sie in sich nichts Anderes darstellen als die Summe derselben, um so ähnlicher sein müssen, je ähnlicher ihre einzelnen Elemente unter einander sind" (page 258).

[3] See A. Höfler, *Psychologie*, Wien und Prag (1897), p. 152.

composed of the same typical elements present great variability of form and function. We may say, in general, that any structure made up of heterogeneous elements—if it be anything more than a mere collection or heap—implies arrangement, plan, pattern, and not simply addition of abstract units. Mechanical processes, even, furnish illustrations. The sand on the vibrating plate falls into definite figures, sediment is laid into a stratum, the mountain is pushed up into a characteristic shape, the cooled substance falls into a determinate form of crystallization. And should we not expect that, in any formation as complex as a mental formation and in one arising under as complicated and variable conditions as it arises, the characteristics of a group should be determined, not only by the elements cohering, but also by the manner in which these cohere?

The combination of qualities must, then, take account of modes of combination and patterns of structure. Such combination cannot properly signify simple addition in a one-dimensional, abstract, number series. Considered thus, Ehrenfels's statement becomes anything but axiomatic. Once we admit that qualitative groups may have properties or attributes or characteristics which are not to be found in the elements grouped, the summating process must either be thrown out of court in any inquiry like the present, where a full description of qualitative components and resultants is required, or it must be modified to suit the facts and thus lose its axiomatic character. It appears equally incorrect to say that, in psychology, $1 + 1 = 2 + x$ or that mental synthesis is a simple process of addition which follows the time-honored traditions of arithmetic. It is no adequate description of the fact to affirm that, when *c* and *g* are sounded together, 1 tone + 1 tone = 2 tones + form quality. The equational form of statement is itself out of place. If psychology had to deal only with groups of simple elements which lie in a one-dimensional series (as 1, 2, 3, . . n) in which no substitution or transposition were possible, the formula of the sum might, perhaps, be applied. But suppose we have such a series as the following: 1, 2, 3, 4, 5, 6, 7, 1′, 2′, 3′, 4′, 5′, 6′, 7′, 1″, 2″, 3″, 4″, 5″, 6″, 7″. . . . . In this series, a group from the primed section may be more like groups well above and below it than like groups of its immediate neighbors. The matter thus becomes more complicated. And yet this is what we actually do have in the case of melody. We may have the same melody played or sung in different octaves. The point of the matter lies here. Melody is several degrees removed from simple sensational complexes—if by 'sensation' we mean a purely elemental bit of mental furniture. There are a great many things to be known about mel-

ody and several theories in regard to its basis which must be reckoned with before we are in a position to decide on the presence or absence of qualities of forms. Melody is a matter of musical practice and of æsthetics. To understand it, one must understand the various phenomena of fusion, of consonance and dissonance, of clang relationship and the canons of musical structure.

I shall not enter into these things. I point them out only to show that one cannot say off-hand: "melody is more than a sum of sensations and, therefore, contains a new conscious quality which we will call a quality of form."

The illustration from spatial form is not much more convincing. It assumes that the spatial sensation-element is a locality-determination—a 'hereness' or a 'thereness,'—and then asserts that a space form is more than these, because the form may remain while these change, *i. e.*, a form is the same form whether in *this* place or *that* place. It may be answered that the particular theory of space that a man holds decides what he shall consider as the spatial element: it may be a locality-determination, or it may be something quite different. Moreover, the general argument against 'summing' qualities applies here as elsewhere.

Still the problem remains, and we shall look for its clarification in simpler and more unambiguous examples. The fact that both Mach and Ehrenfels have in mind is this. We perceive unitary things and not random qualities agglutinated in haphazard fashion. To these unitary objects of perception must correspond some determination in consciousness. What is it? Is it something in the elements or is it something new added when qualities are combined? In short, what is the 'togetherness' of conscious processes? For my own satisfaction, I conceive the problem in terms of some such simple combination as the simultaneous or successive sounding of two simple tones—say *c* and *g*, or the perception of liquidity or a taste fusion. These give us all the necessary data; the unity of the experience and the elements. Moreover, a group as simple as the fusion or the tonal sequence *cg*, contains everything that Ehrenfels's definition demands for the form quality. The interval—the fifth—remains though the elements be changed; a transportation to *da* or *fc* does not destroy the 'fifthness.' Now we have reduced our form quality to its lowest terms. The question arises, is the "positive ideational content," the *Etwas Neues* still present? Shall we say with Stumpf that there is only a characteristic form of grouping, a fusion of a given degree, of a given unitariness, or is it necessary to admit the inadequacy of the tonal elements given through analysis and to add "qualities of form?"

If we have somewhat cleared the ground provisionally, we may proceed to take up the historical thread of the argument where we dropped it. The discussion is next entered by Professor A. Meinong, of Graz, who, for the most part, seconds Ehrenfels's conclusions.[1] Ehrenfels's negative argument (that like elements produce like complexes) is, he thinks, conclusive; but the more positive arguments for the nature of the new factor in the complex must, says Meinong, be carried further. He objects, moreover, to the term 'Gestaltqualität' on the ground that it is ambiguous and inappropriate. He suggests, as a substitute, the phrase, 'funded' or 'consolidated contents' (*fundirte Inhalte*).

The figure is a very forcible one. It is drawn, without doubt, from the terminology of public and private finance. To fund is to bring together accounts, usually floating debts—temporary debts for whose payment there is no special provision—and to issue, in their stead, stocks or bonds, which mature after a term of years; *i. e.*, various liabilities are brought together and put into a common fund. Creditors may be induced to exchange their claims and become either members of the corporation (by taking capital stock) or permanent bondholders of the company. In either event, the scattered claims are brought together and put upon a firm and permanent foundation. The significance of the process is brought out, even better, by the term 'consolidation' which is literally 'a bringing together and making solid.' It means to compress, to pack together, to make more coherent or compact. We have, *e. g.*, in corporate finance, consolidated bonds which are issued by a railroad company against all the lines of a consolidated system, or by a government, in order to bring together, in one single form of stock, various outstanding debts,—as the famous "3-per cent. consols," provided for by Parliament in 1751.

Funded or consolidated contents, are, then, such contents as are produced by bringing together, in a very intimate way, various part-contents. These part-contents, which are merged in the consolidation, are called the funding or consolidating contents (*fundirende Inhalte*) and the new contents produced by the consolidation are the funded or consolidated contents (*fundirte Inhalte*).

Meinong finds the germ of the funding notion in Ehrenfels, who had spoken of the 'fundament,' the 'foundation' (*Grundlage*) upon which a form quality is built up. Meinong carries the notion further by adding to the foundation or the funding basis, the contents which are funded (or founded).

[1] *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, Vol. II (1891), 245.

He also suggests that since 'fundament' has a specific meaning in comparison (*i. e.*, it refers to the two things which are brought into relation—as when orange is compared with red), it is better to substitute the word 'members' (*Glieder*) for the wider significance. And since a word is needed to cover all the conscious factors involved in consolidation, he proposes the term 'complexion.' The melody, *e. g.*, is a complexion. It contains both the consolidating contents—the various notes played or sung (the members of the complexion)—and the consolidated contents; *i. e.*, the new factor that emerges when the notes are taken together, the unifying factor in the complexion, the "taken-togetherness" itself, the unity of the new fund that cancels the old debts. Meinong is able, by these modifications (which are really nominal rather than essential modifications of Ehrenfels's doctrine), to bring the complexion into connection with the relation. The relation also implies consolidation; for there is the same sort of a unity formed when one thing is related to another as is to be found in the melody or the spatial form. The relation is a certain kind of a consolidation seen from the inside, so to speak; *i. e.*, you compare A and B (set them into relation) and you get a result—'similarity'—which is not in the members. It is really a funded content. Where you get a relation and where you get a complexion by funding your members, has to be determined. In melody, *e. g.*, or in the musical chord, you do not set each element into relation with other elements (that is to say, you do not compare the parts) but you get a unity, a fusion. The elements flow together into a complexion. In comparing red and yellow, on the other hand, there is more of an exertion of the subject and a (similarity) relation emerges. The *funding* is more or less spontaneous, whereas there is a distinct *act* of comparison.

Meinong has undoubtedly thought the matter out more thoroughly than Ehrenfels. Naturally: Ehrenfels broke ground. We have now, in place of the single term, "form quality," the more analytic terms, "members," "complexion," "funding" and "funded contents."[1]

More recently,[2] Meinong has extended his researches into funded contents and has added several new concepts. He brings both complexions and relations together into a more generic class which he calls *objects of higher order; i. e.*, objects which are intrinsically dependent upon other objects. The relation (*e. g.*, 'difference'), exists only in connection with objects

[1] Ehrenfels accepts Meinong's new terminology. *Cf. Vierteljahrsschrift für w. Philos.*, XV (1891), 293.

[2] Ueber Gegenstände höherer Ordnung und deren Verhältniss zur inneren Wahrnehmung. A. Meinong. *Zeitschr., etc.*, XXI (1899), 182.

compared; the complexion (*e. g.*, melody) is built upon the members (tones). The object thus founded, *i. e.*, the object of higher order, is called *superius*, the objects upon which it is built—the things related and the members of the complex —are called the *inferiora* of the higher object. Just when the relation and the complexion have been set side by side as co-ordinate classes of objects of higher order, it is something of a shock to learn that a complexion always implies relations and that relations enter into complexions. It is necessary to follow Meinong into his logical tangle only far enough to see that he means that the members of a complex are set into relation and that this relation is vital to the unity of the complexion.[1] The complexion depends upon the relation and the relation upon the constituent members. It is the relation and the members taken together—not as a sum, as a + b + r—but objects-taken-in-relation that make up the complexion. When, however, Meinong finds, first, a relation, r', between *a* and *r*, then a corresponding relation, r'' between *b* and *r*, and relations, again, between these relations, and thus on to infinity, we find the argument unconvincing. Such 'relations' are either psychological fictions or logical abstractions. And, moreover, it must be admitted that the useful term, 'complexion' is indefinitely weakened by an unwarrantable extension of the 'relation' concept. It is to be remarked, also, that the later article is much less significant to us than the earlier one (*Zeitschr.*, II) because it is more epistemological than psychological. It leaves contents (*Inhalte*) for objects (*Gegenstände*).[2]

[1] The writer cannot avoid the suspicion that this much-used term 'relation' is really employed in two different senses by Meinong—even where he does not give notice of a double meaning: (1) in a wider—the more usual—sense (as a relation of similarity) where he seems to understand by it a conscious act which brings about a togetherness-of-contents ("Bewusstsein des Beisammen," XXI, 197), and (2) in the more restricted sense of simple grouping as in a fusion of auditory or visual elements. In the writer's opinion, the two cases are quite different and should always be distinguished. It is a question, as we shall see later, whether this bringing together of conscious contents is itself a conscious process or act or whether it is not —at least in the second case just cited—a logical formulation, substituted for a simple standing-together-in-consciousness.

[2] *Cf. Ueber Annahmen*, von A. Meinong, Leipzig (1902). In this most recent discussion, Meinong explains (p. 8) that his earlier phrase 'funded content' should stand 'funded object' since that which is really produced by funding is an object and not an idea (*Vorstellung*). This changes the case not a little. We may readily grant that it is impossible to dissolve an object into a series of sensational elements. But such a concession does not make it necessary to add a new unifying factor to consciousness. If we take into account the fact that mental processes are not only existences but also symbols which refer beyond themselves, to objects, we see that the existential side of the

There is, however, one special divergence in the two articles that deserves to be noticed. In the earlier account, consolidation or funding covers all ideas (*Vorstellungen*) which are dependent on others; *i. e.*, those which have *Grundlagen*. Every complexion and every relation, apparently, involves both funding and funded contents. In the later article, a distinction is drawn between ideal and real relations and complexions, and only the ideal are said to depend upon funding. Real objects are those that exist in actuality, or that may exist, —as a house, a book, a color, a tone. That which does not and cannot have actual existence (*existiren*), although it *is* (*besteht*), is an ideal object (XXI, 198). 'Deficiency,' 'limit,' 'past,' are instances. The distinction of real and ideal is carried over to relations and complexions. 'Similarity' is an ideal relation, 'fourness' (as in the enumeration of four objects) is an ideal complexion; real relations and complexions, on the other hand, are such as are perceivable (*wahrnehmbar*); as the relation between a color and a spatial locality or the complexion of a tonal fusion. In the real relation and complexion, the perception determines the superius; in the ideal relation and complexion the superius is determined by the process of funding. Thus "funding performs for ideas of ideal objects the same function as perception (*Wahrnehmung*) performs for ideas of real objects" (203). The point of this distinction is, if I do not misinterpret the author's very condensed account (he promises to give a full discussion of the subject), that funding is an operation, an act (apparently, a 'judgment,' p. 201) by which an object (superius) is wrought out, 'produced,' from the inferiora. 'Funded objects' stand over against 'objects of experience' (*Erfahrungsgegenstände*). Both arise immediately; the one through the process of funding, the other through the process of perceiving. Just exactly what the difference is remains, at the end of Meinong's discussion, almost as much of a mystery as ever. It is not clear why funding should, in the later account, apply to a *single class* of objects of higher order (ideal complexions and relations). The criterion "logical necessity" under which the superius is said to be funded out of the inferiora (as the ideal relation, 'difference,' in the comparison of A and B) seems also—against the author's inten-

object's unitariness may be just the togetherness of the processes as they stand arranged. We should have, then, on the side of consciousness, merely the plan of arrangement of processes and, on the side of the object, the functional aspect of this plan or pattern; namely, the unitariness, the wholeness, of the object perceived. At all events, we must keep distinct the psychological and the epistemological problems of perception. Then we shall see that the establishment of a cognitive 'fund' need not imply a corresponding 'fund' among sensational elements.

tion—to cover cases of real relations and the "objects of experience" which are based upon them; *e. g.*, an interval in tonal fusion (one of Meinong's instances of a 'real relation') follows as inevitably from the nature of the tonal elements involved as the judgment 'different' from the comparison of red and green. If funding is dependent upon "logical necessity" in the emergence of the superius, why, then, is not the fusion as truly funded as the (ideal) difference-relation?[1] In the case of melody Meinong does admit this 'logical necessity' that makes the melody a funded complexion. But how the melody can be unequivocally determined by the elements (tones) and the fusion not, it is difficult to see.

Some additional light is thrown upon the subject of consolidated contents by H. Cornelius (Privatdocent in Munich). Cornelius,[2] instead of starting from simple contents and asking what occurs when these are brought together, starts with the complex, which he calls the fusion. He affirms that the primary mental structure is a whole which is only gradually broken up into parts by the analyzing process of attention. What do we see in a thing, Cornelius asks, before we come to know it intimately? Why, he answers, a big, unanalyzed, undissected mass (*Gesammteindruck*). Just a whole. Precisely as the unmusical individual hears a chord without analyzing it or as most of us hear the clang color of a musical note or perceive a face. By attending, now to this part of the mass and now to that, we are led to the inference that the mass is really complex, made up of parts. If this critical scrutiny be repeated often enough, the mass finally falls to pieces without an effort; *i. e.*, we analyze 'on sight' and spontaneously. And when we do—and this is the important point—something disappears, is lost. Analyze your note and clang color disappears; play your melody slowly enough to make it fall to pieces and only a detached series of notes is left. This change, says Cornelius, is an actual loss in contents. Thus he comes to the same conclusion in regard to the existence of a unique factor in the complex, or the complexion, as Ehrenfels and Meinong

[1] Just as this article was ready for the press the important monograph "Ueber Annahmen" came to the writer's hand. The monograph gives a systematic setting to the phenomena of funding, of complexions and of objects of higher order. Unfortunately, no adequate account can be taken of it here. It seems, however, to represent the same position in regard to the concepts with which we are dealing as the *Zeitschrift* article (XXI) to which we have made frequent reference. "Logical necessity" is again given as the criterion of consolidation. "Fundirte Gegenstände sind mit ihren Fundamenten durch Nothwendigkeit verknüpft" (p. 12).

[2] *Vierteljahrsschrift für w. Philos.*, XVI (1892), 404, and XVII (1893), 30.

who worked up from below instead of working down from above.

If we grant Cornelius's presupposition, then, we get additional evidence for qualities of form (Ehrenfels) or consolidated contents (Meinong). For if some 'positive conscious content' is lost in analysis, it is quite possible that this is no other than the funded content which characterizes Meinong's complexion. Funded content means, however, for Cornelius, the 'sensation-whole,' the unanalyzed fusion and not, as for Ehrenfels, something added to the sum of the parts. It is to be noted, moreover, in passing, that, although Cornelius and Meinong both contend for the existence of funded contents, their theories of analysis are radically different. Meinong (who is happiest when he is standing sponsor for a concept) develops an elaborate terminology and technique to explain the process of analysis.[1] It should be remarked that it makes little difference to our main problem whether the fused undifferentiated whole (*Gesammtvorstellung*) or the analyzed complex were the original type of mental formation. Our primary question is a question of content and not of origin.

One further point only is it necessary to mention. Although analysis, the breaking up of a whole, does not create the sensational elements, it may, nevertheless, says Meinong, alter the funded contents. In the clang, *cg*, for example, one gets different funded contents and, therefore, different complexions according as one attends to *c*, or to *g*, or to *cg*. To state the matter in general terms, the process of funding and the character of the complex depend not only on the quality and the intensity of the funding contents (the inferiora) but also upon the direction of the attention. It is to be noted that both Meinong and Cornelius go a step beyond Ehrenfels in this particular. For Ehrenfels, the funded contents are maintained so long as the relation of the parts is maintained. Transposition, *e. g.*, does not destroy the funded melody. For Meinong and Cornelius, on the contrary, the funded contents can be altered, even without change of elements, by a shift of the attention. For the later writers, then, funding is a more subjective process, more independent of external conditions, than it is for Ehrenfels.

An addition to our systematic knowledge of complexions is made by Stephen Witasek (a pupil of Meinong at Graz). Witasek[2] works out Ehrenfels's instances of *Gestaltqualitäten* which are themselves based upon other *Gestaltqualitäten; e. g.*,

[1] For Meinong's views of the function of analysis see *Zeitschr., etc.*, VI, 340 and 417. Cornelius's account of fusion and analysis should be read in connection with Stumpf's *Tonpsychologie*, Vol. II.

[2] *Zeitschr., etc.*, XIV, 401.

a polyphonic composition made up of different 'voices,' each of which is itself a complexion. These complexions, which are twice removed from simple unfunded elements, or members, he calls "complexions of higher order." (This term is to be kept distinct from Meinong's "objects of higher order" which embrace the objects of *all* complexions and relations).

The most important part of Witasek's article deals with the formation of complexions. Some complexions, he says, are made quite automatically. The partials in the note combine (are funded) in a perfectly unequivocal and effortless way, producing the clang with its characteristic color. The case is similar with the melody. The funding does itself, so to speak. But in the case of complexions of higher order, the possibilities for funding are increased. In a contrapuntal arrangement, *e. g.*, one might find each voice funding by itself and then uniting with other voices as a complexion of higher order, or the primary complexions might be harmonic complexions between the simultaneous parts of the several voices, or, again, the funding might proceed quite irregularly by combining successive notes from different voices. These and still other possibilities arise where complexions of higher order are involved.

The complexion that actually does issue from all these possibilities is decided by many things. The first prerequisite is that a group of elements should be disentangled from the mass. This is often accomplished externally; *e. g.*, the solo voice is more intensive than the accompaniment. Then, too, it has its own distinctive clang color to set it off from the other sounds and to hold it together. And, finally, spatial position and pitch may also contribute. But beyond these external conditions, Witasek sees a special activity of the subject working upon the members, when they do not, of their own accord, fall into definite complexes.

At this point there is a dissenting voice raised on the subject of funded contents. F. Schumann (Stumpf's assistant in Berlin) takes the field against the champions of consolidation.[1] Schumann gets his bearings from unpublished lecture notes of G. E. Müller's. Müller had said that we apply various predicates to both simple and complex mental contents by noting the similarity of these contents to others and by placing them in various groups.[2] A simple tone, *c*, falls into an intensity group, a quality group (the one-dimensional scale of pitches), and a clang color group. In a similar way, mental *complexes* evince similarities and fall into groups. In the second case, no more than in the first, is there a special relating activity, a

[1] *Zeitschr., etc.*, XVII, 106.

[2] Essentially the same as Hume's argument on the *distinctio rationis*, *V Treatise*, Bk. I, part 1, sec. vii.

higher mental faculty involved. This statement seems, to Schumann, to stand directly against the contention for a new kind of relating activity which is involved in the theory of funded contents.[1] Having taken his general position, Schumann proceeds to criticise more circumstantially. Ehrenfels's negative proof has, he thinks, some weight; but the inference to the 'positive ideational contents' is unwarranted. Melody is a poor illustration because it has not yet been sufficiently factored for us to tell what it contains[2] and the "determinations of position" (*Ortsbestimmungen*), the elements out of which spatial figure is said to be funded, are fictitious elements from which no conclusions such as Ehrenfels's can be drawn. Moreover, Stumpf has disposed of clang color (as Meinong himself admits) by referring it back to a 'tonal color' in the elements and temporal unities may be shown to be bare sensational stuff. The unitariness, the wholeness of complexes, upon which so much stress has been laid, is, first of all, for Schumann, a unitariness in the sense that the complex *functionates as a whole* in influencing reproduction, judgment and feeling. Schumann is of the opinion that the 'funded' part of the complexion may be resolved into feelings and accompanying ideas.

This destructive criticism is couched in too general terms

[1] Precisely how the champions of consolidated contents conceive the 'activity' to which Schumann objects, it is not always easy to decide. Ehrenfels denies, as we have seen, any special activity. Meinong disagrees with Ehrenfels's argument that the form quality is given invariably with the elements (*op. cit.*, II, 260). Elements are funded only under quite definite conditions. There must be an act of the subject; and, in comparison, Meinong maintains, "the subject must contribute considerably more than in the perception of form or melody and yet, even here, not all is left to the funding contents." In another place (XXI, 201), Meinong says that the superius, 'difference' (as in comparing A and B), demands not only an act of judgment (and "Alles Urtheilen ist ein Thun"), but also a working over of the materials with which the judgment has to operate. Again (XXI, 204), funding is spoken of as a 'process' (*Fundirungsvorgang*), which may be ushered in by what are called the "higher intellectual operations." Still again, funding is called a "producirende Thätigkeit" (*Ueber Annahmen*, page 9). Witasek goes still further and declares for a synthetizing activity by means of which the will exerts an influence on the formation of complexions of higher order. "Der fundierte Inhalt ist nicht lediglich Resultat eines blind wirkenden psychischen Mechanismus, sondern wir selbst fassen nach eigenem Ermessen die einzelnen Bestandstücke zu diesen oder jenen Gruppen zusammen und bedingen so die Form der zu bildenden Komplexion höherer Ordnung." (*Zeitschrift, etc.*, XIV, 426.)

[2] This objection differs from the one urged above (p. 277). Schumann pleads general ignorance of melodic form. My own contention was that the theory of formal elements does not take account of what is actually known about melody. It presupposes that melody is just tonal sensations or these *plus* a form quality. Meinong's reply to Schumann (XXI, 222) does not touch this point.

and is too little thought out to be entirely convincing, but it is, nevertheless, vigorous and pointed. Meinong replies[1] at length taking up Schumann's points in great detail and reaffirming his old position taken several years previously.[2] Cornelius,[3] on the other hand, thinks that he sees a chance to reconcile Müller's view (which he himself has sustained in his *Psychology*[4]) with the doctrine of Ehrenfels and Meinong. Just as quality and intensity and extent are attributes or modifications of the sensation, so, he maintains, are form qualities and funded contents attributes or modifications of complexes. And they are brought out in the same way; namely, by noting the resemblance of the sensation or of the complex to other sensations or other complexes; by putting it in a group. It is, therefore, not correct to speak of the modification or attribute (*Merkmal*) of a complex as a new content which depends upon the juxtaposition of elements, unless one means by 'content' *abstract* content; that is to say, one got by abstracting a single aspect, as the 'fifthness' of the fifth or the 'thirdness' of the third. There is, Cornelius continues, no reason why the similarities of complexes should depend upon the similarity of their parts. They may be functions of the complexes as wholes. The form quality is not, then, as Ehrenfels and Meinong say, a new positive content (*Inhalt*) but an attribute, a characteristic, a property (*Merkmal*).[5] We shall, then, have to speak of 'fundirte Merkmale' instead of 'fundirte Inhalte.' Considered thus, form quality is just a name for the similarity of complexes, but is not an explanation. It is a matter of direct experience.

Cornelius still leaves unanswered the question, 'how do these new similarities between complexes arise?' He does this purposely, because he is writing what purports to be a purely descriptive psychology; a plain account of conscious events. Professor Lipps, on the other hand, who believes in an explanatory, as well as a descriptive, account of mind, insists[6] that the form quality rests on unconscious psychical processes. In the connections obtaining between mental contents we see only a product. The real causal factors that produce the contents and the connections between them lie behind the scenes, inaccessible to experience.

This view of funded contents, is, one may easily say, as

[1] *Zeitschr., etc.*, XXI (1899), 205.
[2] *Ibid.*, II (1891), 245.
[3] *Ibid.*, XXII (1899), 101, and XXIV (1900), 117.
[4] *Psychologie als Erfahrungswissenschaft*, Leipzig (1897).
[5] For a criticism of Cornelius's Theory of Abstraction, see Meinong, *Zeitschr., etc.*, XXIV (1900), 34.
[6] *Ibid.*, XXII (1900), 383.

strong or as weak as the general Lippsian doctrine of unconscious psychical processes.

With the admission of the funded content as an attribute or a characteristic, we begin to see the end of this long and involved discussion. F. Schumann writes again,[1] giving a large number of significant instances from the domain of visual perception and accepting Cornelius's view of the funded factor as an attribute (*Merkmal*) which rests upon a peculiar and close consolidation of elements in a complex. He shows that in spatial figures there is a greater or lesser unification of the parts which corresponds closely to the fusion degrees of tones;[2] *i. e.*, an approximation of a complex to a single impression. The unitariness is an attribute of the complex which makes it possible to judge the likeness and difference of complexes as such. *E. g.*, the essential characteristic of the square is the like value of the sides (as against the oblong whose two long sides are characteristic) and the rectangularity of the corners. We do not stop to figure these characteristics out, but they strike us at once; they are an immediate "sensuous moment" (*cf.* Mach's term, "space sensation").

G. F. Stout has given in his *Analytic Psychology* (1896) some account of form qualities and funded contents. Stout's position is essentially the same as Ehrenfels's and Meinong's; though his theory of analysis, as a process which works a fundamental change in mental contents, or 'presentations,' is much like that of Cornelius. For Ehrenfels's 'Gestaltqualität,' Stout substitutes the phrase 'form' or 'plan of combination.' He uses the old arguments to show that the apprehension of form is a "constituent of consciousness comparable . . with the perception of red or blue" (Vol. I, p. 66). It is not, then, simply a mode of mental combination, but a distinct kind of consciousness.

It is time now to ask, 'what is the real outcome of all this discussion over form qualities, complexions, and objects of higher order?' Psychology has certainly gained from the long decade of debate. If the whole mass of literature, which we have only just glanced at, did nothing more than fill, even temporarily, a gap in the psychological system, it would serve an important purpose. But it does more. It shows, in the first place, how misleading is such a rubrication as 'sense' and 'intellect.' Mind is not so simple as that one can say of a

[1] *Zeitschr., etc.*, XXIII (1900), 1.

[2] The fusion is not, to speak strictly, a characteristic, or *Merkmal*, if by fusion we mean fused contents. It is only the 'fifthness' or 'thirdness' or 'octaveness' which would be considered the new characteristic of the fused complex.

mental formation, 'this is either a sensation that has found its way into mind or a sheer spiritual creation that mind has evolved.' We must reject this unfortunate dichotomy and ask quite concretely the question that we raised at first; namely, "what is the actual plan of mind?" And it is not difficult to see that the investigators whom we have been reviewing have begun at the right end of the problem. They have, *i. e.*, taken comparatively simple instances that do not fall wholly either under 'sense' or under 'intellect,' but which stand on the dividing line. The first point raised was this: are these simple perceptual groupings just sensations (Mach) or are they something more? The writers who contended that they were 'something more' have been concerned to show precisely what the new factor is and what relation it bears both to 'sense' and to 'intellect.'

In the second place, the discussion has shown that a complete descriptive account of a mental complex demands more than an enumeration of its constituent elements taken as isolated units. The complex does not 'feel' as a sum of such elements would feel. This is true whether the 'funding' concept be valuable or worthless.

And, finally, the problems which have been raised in the literature give psychology a good opportunity to test the validity and the adequacy of its mental structures. If its elements prove inadequate when one comes to synthesis, they must either be augmented or their claim to represent the whole of mental tissue must be recalled.

But, even though it be granted that the discussions referred to have borne fruit, we must admit that the specific problems raised have not all been satisfactorily solved. There are, in the writer's opinion, two general criticisms of the results that remain to be made. (1) Where a new 'funded' factor has been found necessary, the true nature of psychological elements has not, as a rule, been kept in view. (2) The concept of 'activity' in the process of funding has not been made clear and unambiguous.

Unfortunately, a specific justification of these criticisms and a positive contribution to the subject would call for a separate article. It may not be impossible, however, to indicate, in a few words, the direction which, it seems to me, promises quickest approach to a solution.

The two concepts to conjure with are the concepts of analysis and attention. It is useless to attempt to decide on the existence of funding contents or funded objects until an agreement is reached on the quale and the functions of analysis; and it is, likewise, futile to dispute over the mental activities in-

volved in funding until the possibilities of attention have been exploited.

What I may have to say on these two topics will, perhaps, be more intelligible if I state, first of all, my own conviction on the general question involved. The hypothesis of distinctive and unique conscious structures which characterize mental complexes is to be entertained with caution, if not with suspicion. Their intemperate use in certain of the treatises that we have discussed is both unnecessary and indefensible. I prefer to say that the essential nature of a complex is determined, not by a funded or formal factor, but by the character of the elements themselves, the connections into which they fall and the state of attention in which the complex is given.

The theory of funded elements derives its chief plausibility from an inadequate definition of element. Reference to our two types of analysis (p. 271 above) will make this clear. External analysis, which fixes attention on stimulus and, particularly, on the progressive simplification of stimulus, is certain to yield abstract, artificial, isolated and self-centered units—as 'red' 'strain,' the tone '*c*' 'pressure,' 'sweet,' 'pleasantness,' etc. Such elements as these are always oblivious to every existence but their own.[1] Each quality is self-contained, sufficient unto itself. This view of elements finds, it is true, ample justification. It is a wonderfully serviceable view in mental analytics. But the point is that the view *is essentially* analytic. If we want to know what mind is like in the concrete, we must supplement the type of analysis by the second, internal, type. That is to say, we must explore all sides of a complex, *as a complex; e. g.*, the visual colligation or the auditory fusion or the melodic sequence. We must search out, in turn, the constituent parts of the complex, while the unanalyzed or half-analyzed remainder is maintained in the background. By this procedure, only, do we get at mental elements as they stand in connection, as they make up the actual living tissue of mind.[2] The element then becomes a simple thing, but a thing with its connections upon it, with its real 'local signature' in the anatomy of mind. But if the element is a being with a *status*, with

[1] It is, apparently, this kind of a mental element that James rejects with so much fervor in his chapter on The Mind Stuff Theory (*Psychology*, I, ch. VI). In his impatience at associationists, James overdoes himself in asserting that we cannot "mix feelings as such." He is even led to the absurd statement that the taste of lemonade does not include the qualities acid and sweet (p. 158).

[2] *Cf.* C. Stumpf (*Tonpsychologie*, II, p. 279): "Als Teilerscheinungen im weitesten Sinne können wir schliesslich nicht blos die in einer Vorstellung enthalten absoluten Elemente (die einzelnen Töne, Linien) bezeichnen, sondern auch die zwischen zwei solchen Elementen stattfindenden Beziehungen."

a place to fill in one group or another, what more is needed to make up the group than just these elements and the plan of arrangement, which is nothing but the elements taken together? Does not the 'funded content' become superfluous? Nevertheless, two things remain to be said by way of adding plausibility to the position. (1) The peculiar unity of the complexion (Meinong) may serve as an argument for a 'plan of arrangement' as well as for a funding process. This unity —whether it take the form of 'fifthness,' or 'octaveness,' or 'squareness,' or 'rectangularity,' or 'violinness,' or 'trumpetness'—need not be the result of a 'unification' content, apart from the ordinary visual or auditory elements. These things are simply the mode, the pattern, in which the elements (as revealed in internal analysis) are set forth. They represent group-characteristics for which, to be sure, we shall look in vain in the abstracted elements of external analysis. Nevertheless, they call for no special conscious moment foreign to the constituent members themselves.

In the second place (2), no account of the psychology of complexes—even of the simplest complexes—can be completed without reference to attention. The skeptical reader may have anticipated the argument at this point by saying that here at last the *Etwas Neues*, the *deus ex machina*, must reveal itself. But, surely, this depends entirely on what one means by attention. Of course, if attention is a particular process among other processes, appeal to such a factor will not remove the difficulty which we are trying to avoid. But, if attention be conceived as a *state* or *condition* of consciousness, with well-marked characteristics and perfectly definite consequences, it may well be that it is the one moment that is lacking to our explanation. It will be such a moment only on condition that the attentive consciousness is a synthetizing consciousness, only on condition that the formation of mental complexes is one of the functions of the attentive consciousness. This is not easy to prove—although it is accepted by many psychologists. A demonstration of the point really requires a theory of attention. It would be foolish to attempt even the outline of such a theory at this late point in the argument. There are, however, two sets of facts which may be set down as favoring a synthetic function of attention. In the first place, introspection bears witness to the fact that objects present themselves as wholes while we attend. *Because* we analyze under attention is no proof that we do not, at the same time, synthetize. Experience, it is true, comes in 'lumps' to the inattentive consciousness. But these lumps are not the unitary objects of perception that stand before consciousness when its parts have been not only brought into focus but also brought together in

definite arrangement. Our second argument falls to us from genetic psychology. One of the principal functions of the nervous system is to collect and to co-ordinate the experiences of the organism. It brings together the various aspects of a situation and reflects them in consciousness. It is easy to see that attention to a 'situation' rather than to a disconnected set of sensations and feelings is the more favorable to the organism. Hence we may well suppose that one of the results of natural selection has been to sanction the tendency to attend widely and to group comprehensively the elements of an experience.

At the same time, this argument from genesis proves to be more than an argument for a synthetizing attention. It also confirms our general remarks about plans of arrangement, for it shows us that the simpler mental groups, at least, have been made at the behest of nature. They correspond to situations which have appeared over and over again in the history of the individual and of the race. We can pick out hundreds of spatial and temporal and qualitative groupings which have got themselves formed by persistent and united appeal to the organism; tactual perceptions, smell and taste complexes, auditory fusions, perceptions of bodily position. It is, then, rather the finger print of nature that we trace, first of all, in the 'complexion,' than the operation of a unique mental factor.

The arguments from attention are, I admit, inconclusive. My reasons for bringing them forward are simply these. I have emphasized the concept of attention because it is one of the corner-stones of every modern psychological system; because it has been thoroughly analyzed, and because it is, without any doubt, closely connected with the phenomena which we have been discussing. Every descriptive account of mind involves the attention; from Herbart down, the concept has been exposed to a searching criticism—we know, now, its characteristics, its concomitants and its effects;—and, finally, it lies at the basis of perception and of thought. Why not, then, use it, alongside the concept of analysis, in preference to any ambiguous and misleading 'productive activity' or 'interference by the subject,' or *psychisches Zuthun* or 'newly created content,' in analysis of the complexion?

I may say, however, that in spite of divergence of opinion, Meinong's concept of 'complexion' has, to my mind, much to recommend it. It is an improvement on Ehrenfels's 'form quality' because it emphasizes the organization of elements rather than the *mere* addition of a new quality. Meinong does not, however, move far enough in the direction of organization. His notion of funding or consolidation is, after all, hardly in accord with the facts. These terms suggest too strongly the

obliteration of the elements at the expense of the funded contents. To speak strictly, funding, in the literal sense, is only the extreme limit of the process of unification—a limit seldom, if ever, reached in experience.

I should suggest in place of 'funding' and 'complexion' the terms 'incorporate' and 'incorporation.' 'Incorporation' has the advantage of covering all grades of dependence and independence of the parts; and, at the same time, it suggests intimate union, close organization. Furthermore, instead of implying a new conscious structure, it emphasizes the characteristics and functions of the incorporated mass, taken as a whole.

It is only fair to say in closing that the various terms that have been proposed in connection with the present discussion really cover a heterogeneous mass of psychological material which stands in sore need of classification. There can be no doubt that the simple fusion of tones and the judgment of similarity between objects—to take extreme cases—involve very different mental processes. The clearing up of these differences and the systematic envisagement of the general question are, at present, perhaps, the greatest desiderata in the problem of mental arrangement.

THE MOON IN CHILDHOOD AND FOLKLORE.

By J. W. SLAUGHTER, Hon. Fellow in Clark University.

I. INTRODUCTORY.

The safest way to gain a foothold for a study of this kind is to outline at the beginning its purpose and bearings. That its scientific value depends on very definite limitations is obvious to any one familiar, even in small degree, with the subject matter dealt with. The psychologist has heretofore necessarily limited himself to a study of the simplest kinds of mental activity, and excluded everything that seemed too complex for his methods. This led to the relative neglect of a group of processes which have lately been brought into much greater prominence by the genetic method, namely, the instincts and instinct-feelings. Whatever may be meant by these terms, and their connotation is as yet very indefinite, we may at least take them as meaning a series of definite functional relations to the organism's environment. No one, in the present state of inquiry, can seriously doubt that these elements, having behind them all the accumulated force of the evolutionary series, are the chief determining factors in individual and racial life. While the complex organization of human mental life precludes the possibility of tracing the instincts with the same degree of definiteness as in the animal series, yet they mark out with no less certainty the broader areas of human activities. The fact remains, however, that genetic psychology finds it necessary to take a long leap in passing from the animal to the human. The psychological "missing link" is not one but many. In order to supply these lacunæ in the line of development, a new branch of inquiry has been inaugurated and prosecuted with remarkable success, namely, the study of the child in all the stages of growth. But results here must suffer from the obvious limitation that the child's development is only a condensed index of what took place on the larger plane of race history. The steps are passed over too rapidly, and the necessary social environment is too deficient or too false to the child's nature, for the characteristic psychical states to take on definite form. Better conclusions are obtained if the results of this work are connected directly with the accessible data in the field of race-history. This latter group of facts is derived from two sources, the study of uncivilized races, and

the study of civilized races in their stages of formation. The second of these sources while less accessible is by far the more prolific in materials and interest. The reason it has been relatively disregarded is probably the unsettled state of the science of mythology.

Not many years since, and to some extent up to the present time, it was customary to regard a race's mythology as a curious collection of fantastic fables. Greek deities were studied because Greek sculptors had chosen them for their models, and their legends were investigated because they entered to so great an extent into classical drama and tragedy. Our eyes are just now being opened to the fact that each of these stories is a vast repository of psychological material, representing in crystallized form the accumulated experience of a long process of development. Psychological insight adds immense significance to the Greek and Teutonic epics. Very little is added to the Homeric story when Schliemann tells us that there was a fortified town on the Asiatic coast which the Greeks besieged and conquered. In this mixture of Dichtung and Wahrheit, the former only is worthy of study. It is in the figures of the heroes, the character of Achilles, the treatment of man by man, the games at the funeral of Patroklos, the actions of Helen and Clytemnestra, and above all the circle of divinities in the Olympic council, that scientific, as well as æsthetic interest must center. When we reflect, again, that our own religion and civilization are but further elaborations of myths and legends already outlined in the Vedas, the Homeric epics and the Norse mythology, we are in position to estimate the value of psychological investigation in this field.

While the linguistic school of comparative mythology can hardly expect the assent of the psychologist to all its claims, yet it has made one contribution which must be the starting point of all investigators, the fact that the chief mythological personages are ultimately representations of natural objects and natural phenomena. This connects on the one hand with the biological law of adaptation to the physical environment, and on the other, with the most primitive stages of reflection. We are justified to a certain extent in believing that these early accounts represent what nature actually meant to the most primitive human beings, and their instinctive reactions to it. It is interesting to compare the rigid physical nature of science with the animistic and highly personified environment to which early man actually adapted himself. Out of the feelings and actions which were thought to belong to the ever present and insistent facts of the physical world grew stories and romances which formed the groundwork of mythology. This point is universally admitted. The great similarity of the myth-form-

ing process in different parts of the world, and the fact that it is repeated in the life of every child, point to a psychological solidarity of the race which must have deep-lying roots in the evolutionary series. These early legends, as Max Müller says, "though they may be pronounced childish and tedious by some critics, seem to me to glitter with the brightest dew of nature's own poetry, and to contain those very touches that make us feel akin, not only with Homer or Shakespeare, but even with Lapps, and Finns, and Kaffirs."

With this universal animistic view of nature as a background, it seems natural that a great mythological and legendary accumulation should appear in connection with the moon. The following from Harley is an excellent statement of the case: "The sun, incomparable in splendor, invariable in aspect and motion, to the unaided eye immaculate in surface, too dazzling to permit prolonged observation, and shining in the daytime, when the mind was occupied with the duties of pastoral, agricultural or commercial life, was to the ancient simply an object of wonder as a glory, and of worship as a god. The moon, on the contrary, whose mildness of luster enticed attention, whose phases were an embodiment of change, whose strange spots seemed shadowy pictures of things and beings terrestrial, whose appearance amid the darkness of the night was so welcome, and who came to men susceptible, from the influences of quiet and gloom, of superstitious imaginings, from the very beginning grew into a familiar spirit of kindred form with their own, and though regarded as the subordinate and wife of the sun, was reverenced as the superior and husband of the earth. With the transmission of this myth began its transmutation. From the moon being a man it became a man's abode: with some it was the world whence human spirits came; with others it was the final home whither human spirits returned. Then it grew into a penal colony, to which egregious offenders were transported; or prison cage in which, behind bars of light, miserable sinners were to be exposed to all eternity, as a warning to the excellent of earth."

In the present study, ontogenetic and phylogenetic results are placed side by side, but the attempt is made to avoid the mistake of trying to find cases of exact correspondence. Whatever the doctrine of recapitulation may mean when applied to the later stages of growth, consideration must be shown for the immense difference between the two scales. It could hardly be supposed that the later and more plastic formations would appear with the definiteness of rudimentary organs, or that they would necessarily be fixed at all. The well known swimming movements, for example, or those of climbing, are really not rudimentary, as they have no residue, but are a stage in the

formation of more elaborate movements, to which they are subsumed. It is thought better, therefore, to illustrate a particular stage or tendency in both the ontogenetic and the phylogenetic series by assembling a large number of expressions on each side, and thus showing a general identity rather than in particulars. It may be argued that it is impossible to get the spontaneous expressions of children on account of the prevalence of nursery and folklore stories. This is true, but the argument hardly seems valid when we reflect that there must be a reason for the existence of all nursery stories, and that the interest which receives is identical with the interest which creates. A child's capacity is not a hole that can be filled with anything, but an active, selective interest. In some cases the external influence is, unfortunately, too great, as, for example, in the idea that the moon is composed of cheese. But on the whole, there can be no doubt that in the material presented there is a wide play of spontaneity.

The children's expressions are gathered from returns aggregating 423, of which 321 are from females, 102 from males. This material was collected by Dr. G. Stanley Hall. The Rev. Timothy Harley's *Moon Lore* made the task of collection much lighter on the side of folklore and mythology.

2. Substance, Distance, etc.

Careful inquiry and reminiscence concerning the substance of the moon show that eighteen children, averaging five years, thought it made of cheese. Sometimes the mice eat it horse-shoe shaped, or that it could be fed by throwing cheese up so clouds could catch it; or it was green because the man in the moon fed on green grass; its spots were mould; it was really green but looked yellow, because wrapped in yellow cheese cloth; it was cheese mixed with wax or with melted lava, which might be edible; there were many rats, mice and skippers there; it grew big from a starry speck of light by eating cheese. It is made of rags, 3; or the man in it is stuffed with them; it is a picture with yellow paint, 4; made of yellow paper, 3; putty, 1; gold, 7; silver, 3; honey, 3; cotton, 3; a lucky stone, 1; a cake of ice, 5; of many stars, 3; air, 1; gas, 2; brass, 4; a plate, 3; a balloon, 3; clouds, 8; a ball, 2; tallow, 2; a lamp, candle or gas, 10; of light, 4; of dirt, 3; water, 3; cloth, 2; a bundle of sticks on fire, 1; milk, 1; butter, 2; felt, 1; lightning, 3; made of dead people who join hands in a circle of light, 1; some bright dish hung up, water and dirt like the earth, 1; a dead skull, 1; a water pail, 2; it is God, Christ, or any one else, 8; is the face or head of some dead relative or friend, 5; stuck out through the clouds, or the body goes straight toward the sky and is hidden from us by the head.

The majority under 8 did not know what it was made of, or else gave answers obviously invented *ad hoc.*

It is as big as a cent, my fist, a football, mamma's face, a jack-o-lanthorn, a dinner plate, a flour barrel, a washbowl, a closet, a mill-wheel, a washtub, a hat, a well, a sewer hole, a house, etc. From forty-four such comparisons, I roughly average that its disk seems at least a foot in diameter.

Its distance from the spectator thought to be 12 feet, as far up as you could reach on a step-ladder, a ladder could be set up against it. In twenty-three cases, children want it given them. It could be reached by going to the horizon, climbing a hill or a tree. Six children ran away to get it as it was rising. Surprise is recorded on reaching a hill-top to find it just as far away. Eight wanted to go to the edge, touch or look close at it to see what it really was. When children are eight or ten, they realize that it would take days, weeks or months to walk to it, and a little later they begin to estimate its distance by absurdly extravagant figures or illustrations. Very common is the idea that there is somewhere a ladder, perhaps of strings, that leads to it.

How it got there and stays is one of the most baffling problems of childhood. It flew up, was blown up, swam up, crept, walked, rolled up, was fastened up in many ways by God or Christ, or some one climbed up to the sky, it glided up just as it now moves, it sailed up from the water, it was thrown up and hung or struck, went up in a power or balloon, was born, made or grew there. Younger children think papa or some adult put it there, or it went up by its own voluntary motion, and only older children think it got up by electricity. The age in which most opinions are expressed is nine, coinciding thus with the age of greatest interest in the puzzle as to how the man got in the moon.[1]

M., 4. Concluded it must be hooked on a board, and his playmates said it was mucilage and strings, because God would get tired holding it.

M., 7. Said the Tower of Babel and the pyramids was to put it up on.

F., 8. Thought it was slid up on the rainbow, and once thought the clouds held it.

M., 9. It was put up by the first men who were very tall and stood on each other's shoulders.

F., 10. Worried her mother with questioning how it could stay up there so long and not fall, as a kite or bird could not stay up.

F., 17. Used to wonder by the hour how it could possibly ever be put up so high, and thought out many mechanical devices.

F., 21. Never noticed much about the moon except sometimes it came around as you sometimes see a cloud or a bird. She never thought of its quarters or whether it moved.

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[1] See Miriam V. Levy, How the Man Got in the Moon, 555 opinions, *Pedagogical Seminary*, Vol. III, p. 317.

M., 18. Used to sit and watch the moon to see if he could see it move, and concluded it must jerk along when he was not looking.

F., 23. Once had a panic on finding that the moon ran along just as fast as she did. It kept just opposite her, and she ran home without daring to look behind.

F., 21. Thought the moon was running a race to get home first.

F., 18. Once on a journey seeing the moon in a new direction, thought they had gone around the other side of it, but finally concluded that it was a different moon from that they had left at home.

M., 11. Said it went with us at night to keep off the dark. Twelve children, averaging eight years old, deny positively that it moves at all. It is always overhead and is fastened, or it may move around a little if it got loose, or it would hit the stars, clouds, houses or trees if it moved. Very many looked for feet or wings, said it rolled like a hoop, or slid, pushing everything before it.

M., 8. Sometimes it comes out of the woods, sometimes out of the river, and sometimes over the graveyard. Eleven children thought sometimes it came toward you, or sank back into the sky as they watched it.

3. Connection with Weather.

The superstitions connecting the changes and appearance of the moon with the weather are so numerous and varied that it is impossible to recount them in detail. Moreover, it is unnecessary, as instances can readily present themselves to any one conversant with current folklore. The moon has been almost universally regarded as the principle of moisture, due partly to its connection with tides and partly to the moisture of night. The name Astarte, so important in oriental mythology, in addition to meaning the moon directly, contained also the idea of the watery element as opposed to the fire of the sun. The Mahommetans, according to Millius, held the ancient idea of the moon that it was a star full of moisture, with which it filled the sublunary regions. In India the tradition is universal. In China the moon is the head of the Yin system of which water is a part. Says Grimm: "Water, an essential part of the Norse myth, is wanting in the story of the man with the thorn bush, but it reappears in the Carniolan story cited in Bretano's Libussa; the man in the moon is called Kotar, he makes her grow by pouring water." Among the early inhabitants of this continent, the universality of the belief is well known.

In the book on "Weather Lore," by Richard Inwards, there is a large collection of proverbs pertaining to the moon, of which we will quote a few of the most striking.

Circle near, water far;
Circle far, water near.—*Italy.*

The moon with a circle brings water in her beak.

The moon, her face if red be,
Of water speaks she.—*Zuñi Indians.*

Pale moon doth rain,
Red moon doth blow,
White moon doth neither rain nor snow.—*Latin Proverb.*

A fog and a small moon
Bring an easterly wind soon.—*Cornwall.*

If the moon change on a Sunday, there will be a flood before the month is out.—*Worcestershire.*

Saturday's change and Sunday's full
Never brought good and never wull.—*Norfolk.*

If the full moon rise pale, expect rain.
Sharp horns do threaten windy weather.

It is sure to be a dry moon if it lies on its back, so that you can hang your hat on its horns.—*Welsh Border.*

If the moon show a silver shield,
Be not afraid to reap your field;
But if she rises haloed round,
Soon we 'll tread on deluged ground.

The full moon brings fine weather.

4. The Man in the Moon.

There is reason to believe that a more universal animistic tendency preceded the anthropomorphism which lies at the foundation of most legends pertaining to the man in the moon. The stories familiar to us have deep-lying roots in Aryan mythology, which in the earliest accessible Greek and German forms, apart from vulgar variations, are highly wrought and extremely refined. With more primitive peoples the animistic concept takes the form of lower animals to almost as great extent as that of man. The hare has been a great favorite in all parts of the world, and especially among the common people of India. Says Max Müller: "As a curious coincidence it may be mentioned that in Sanskrit the moon is called Sasānka, *i. e.*, 'having the marks of a hare,' the black marks in the moon being taken for the likeness of the hare." The toad, mouse, cat, lion, bear, fox, have each been seen in the moon, and been the subject of folklore stories. That the reports from children refer to a human form only is probably due to the fact that the story of the man is told them at a very early age. Still this collection of expressions is one of the very best illustrations of the way animistic concepts must have grown up originally. Some of the expressions might stand, word for word, for some of the primitive legends.

Children pick out eyes, nose and mouth in the dark shades of the disk. It is a man's face, a woman's, a child's, angel's or God, etc. Nine children see in it the face of a dead parent or other relative. It is a whole figure of a man or woman leaning over and covering its face and crying, perhaps over the spilled milk

of Jack and Gill, or one is bent, laughing, over the prostrate form of the other.

F., 16. The man was inside and showed only his face. I puzzled a great deal how it could be a man when all poets call the moon feminine.

For F., 12, the moon's face had the map of Europe, Asia and Africa, and a human face.

For F., 7, he was just a man sitting before a big open fire-place warming himself.

For M., 10, it is a man because you can see his long sandy whiskers, if your eyes are good enough.

For M., 7, it is only a small child, and no one can tell whether it is a boy or a girl.

M., 9. It must be a man to be strong enough to give light so far.

F., 7. The moon is made out of a man and the sun out of a lady.

F., 7. We know it is a man because God put him there all alone always, for gathering sticks laughing.

For one, as a boy, it was always a muffled female form with the head heavily veiled, half sitting before some prostrate form, so that the impression was always rather sad. It is the same yet, and he can see no other form. An adult watched the moon for years to see the man's wife and came to dislike him, because he always left her at home.

F., 19. When about 12, I could clearly see a lady's face in the moon, the man was fainter. I thought they were on their honeymoon.

F., 10. The moon must be a man because it is bald-headed.

F., 19. It seemed to me something in front of a face which was behind looking through, and I thought her body was behind it extending straight out behind the face into the sky.

M., 9. He peeps his head out through the sky with his body behind it. Sometimes he looks at us and sometimes he goes to sleep so, with his head out of the clothes.

M., 6. Thinks it the face of Jesus looking out of heaven, seeing everything but looking so kind.

F., 11. The moon man sees and knows everything, but is alone and looks cold and sad. I would like to go up and take care of him.

M., 3, says it is George Washington; M., 4, thinks it Moses; M., 4, thinks it the funny man or Punch; three think he is Santa Claus; two think him a jolly leering kind of a drunkard; one says he is only a candy man; one, Jacob; two, a rabbit.

F., 9. It is a face I know. I love to play with him and I talk to him a great deal.

M., 4. Insists he smokes a pipe and keeps a cow that jumps over a rock.

F., 20. From five to eight or so, I talked and shouted a good deal by spells to the man in the moon, and thought he could hear although he did not answer.

F., 21. I longed to ask him if he was not tired, cold and lonesome, and sorry he gathered sticks on Sunday. I thought God ought to put others there to help him pick wood, and finally thought I saw them.

F., 12. I used to think there was a real man in the moon, and made wishes to him, but now I know it is only the picture of a man.

F., 35. My girl, age nine, has long wanted to tell the man in the moon something, but will not tell me what.

F., 16. I used to think that when the moon looked red, as in rising, the man was very angry; and when it looked far and pale, I thought him sick and wanted to offer him a glass of milk.

F., 20. Used to think he had headache because the clouds bumped his head.

F., 19. Never dared make a face at the moon lest she should be struck dead.

F., 18. I thought the man must love us because the moon shines so gently down on us.

F., 23. Could never understand why the man in the moon and his friends did not fall off, as their heads had to hang down so much.

F., 6. The moon has parties sometimes. He draws a big ring around and admits only a few stars, and perhaps puts on a veil so that we cannot see their feast.

F., 16. Heard it was good luck to courtesy to it and call it lady moon.

The cow, milk and butter as well as cheese are associated in many fantastic ways with the moon, and even the dog's dish and spoon, cat and fiddle, occasionally appear. The man looks like some neighbor, burns brush, gathers sticks, etc. For a few it is just a head cut off, and for others the moon is made for an invisible man, to play with. Many hear of a certain form or face there and peer and strain their eyes, trying to look under, back and around to trace out parts, as we do constellations, failing perhaps to find legs, eyes, finding this too round, that too flat, etc. The man with sticks is sometimes seen, and the spots are smoke from his pipe or a fire there.

Modern European stories of the man in the moon are probably rooted in the Scandinavian legend which still persists in the familiar story of Jack and Gill. Mâni, the moon once took up two children from the earth, Bil and Hjuki, as they were carrying the bucket Soeg and the pole Simul from the well of Byrgir. The resemblance to the common nursery rhyme is obvious. Mr. Baring-Gould says, "This verse, which to us seems at first sight nonsense, I have no hesitation in saying has a high antiquity, and refers to the Eddaic Hjuki and Bil. The names indicate as much. Hjuki, in Norse, would be pronounced Juki, which would readily become Jack; and Bil, for the sake of euphony and in order to give a female name to one of the children, would become Jill. The fall of Jack, and the subsequent fall of Jill, simply represent the vanishing of one moon spot after another, as the moon wanes. But the old Norse myth had a deeper signification than merely an explanation of the moon spots. Hjuki is derived from the verb jakka, to heap or pile together, to assemble and increase; and Bil, from bila, to break up or dissolve. Hjuki and Bil, therefore, signify nothing more than the waxing and waning of the moon, and the water they are represented as bearing signifies the fact that the rainfall depends on the phases of the moon. Waxing and waning were individualized, and the meteorologi-

cal fact of the connection of the rain with the moon was represented by the children as water-bearers. But though Jack and Jill became by degrees dissevered in the popular mind from the moon, the original myth went through a fresh phase, and exists still under a new form. . . . . The girl soon dropped out of popular mythology, the boy oldened into a venerable man, he retained his pole, and the bucket was transformed into the thing he had stolen—sticks or vegetable." This view is supported by Grimm and other authorities.

5. The Moon and Morals.

F., 18. I thought the moon smiled at good girls, and frowned at us if we were bad. Often I could not feel sure which it did, and would ask mamma if I had been good or bad that day.

M., 20. Used to think if he was bad it would come close to earth and punish him.

F., 19. If good, it came near; if she was bad it went back into the sky.

F., 14. Used to think it shone bright if she was good, and was pale if she was bad.

F., 17. Was ashamed and afraid to have the moon see her misbehave or know of her bad acts.

Often children think the moon goes away, or has the clouds cover it, as a punishment for their sins or because it is saddened by them. On dark nights their conscience troubles them. It can see through clouds and houses, and may draw us up as a punishment to work with the stick gatherer. It sees naughty acts far more surely than good ones. It spies, watches and follows us wherever we go, even when we sleep. Bad children try to run away from it, but in vain. Young women, whose windows open only to the sky, draw the blinds so the moon will not see them undress, but one loves to expose herself to it. If children are bad, it looks straight at them. It may not be able to tell who we are, it is so far away; but it is made light so it can see us, and perhaps see our hearts and thoughts. It can look everywhere, and cannot only tell us what our friends at a distance are doing, but their thoughts and feelings. It may have special times to watch us and overlook us at others. It reports to God, Santa Claus, tells the stars. It is bolder than the sun, for it goes out nights.

Here the chief moral elements seem to be, first, an all-seeing eye, second, the hiding or absence of the moon for which they felt themselves responsible. The idea of moral example in the suggestion of being taken up to work with the stick-gatherer is not certain.

In the folklore stories, the moon is frequently regarded as the witness of wrong-doing, the sufferer for wrong-doing, or a warning to wrong-doers. The stories of the thief also furnish

definite cases of moral example. The following Icelandic legend from the collection of Jón Arnason, gives an instance of the moon avenging directly a case of robbery and effrontery. "There was once a sheep-stealer who sat down in a lonely place, with a leg of mutton in his hand, in order to feast upon it, for he had just stolen it. The moon shone bright and clear, not a single cloud being there in the heaven to hide her. While enjoying his gay feast, the impudent thief cut a piece off the meat, and, putting it on the point of his knife accosted the moon with these godless words:

> 'O moon, wilt thou
> On thy mouth now
> This dainty piece of mutton meat?'

Then a voice came from the heavens saying:

> 'Wouldst thou, thief, like
> Thy cheek to strike
> This fair key, scorching red with heat?'

At the same moment a red-hot key fell from the sky on to the cheek of the thief, burning on it a mark which he carried with him ever afterwards. Hence arose the custom in ancient times of branding or marking thieves." The moral quality of the following from the Chinese is unmistakable:

> "*Ming Li of the House of Wei*
> "Reigned 227-237 A. D.

On an Eclipse.—A Rescript. We have heard that if a sovereign is remiss in government, Heaven terrifies him by calamities and strange portents. These are divine reprimands sent to recall him to a sense of duty. Thus partial eclipses of the sun and moon are manifest warnings that the rod of empire is not wielded aright. Ever since WE ascended the throne, OUR inability to continue the glorious traditions of our departed ancestors and carry on the great work of civilization, has now culminated in a warning message from on high. It therefore behooves US to issue commands for personal reformation, in order to avert the impending calamity.

"But the relations of Heaven with man are those of a father and son; and a father about to chastise his son would not be deterred were the latter to present him with a dish of meat. WE do not therefore consider it part of our duty to act in accordance with certain memorials advising that the prime minister and chief astronomer be instructed to offer up sacrifices on this occasion. Do ye, governors of districts and other high officers of State, seek rather to rectify your own hearts; and if any one can devise means to make up for OUR shortcomings, let him submit his proposals to the Throne."

The awful example of the man in the moon as Sabbath-breaker and thief is, of course, familiar in every nursery. The story has many versions, but the same idea. The one best known is supposed to have scriptural warrant, the passage which is its foundation being Num. XV, 32:36. We are told that the man found by Moses gathering sticks on the Sabbath was transferred to the moon. The passage cited merely states that the man was stoned by the congregation, and makes no mention of the moon. The story seems rather to be of Teutonic origin. The ordinary German story is that a man went out one Sunday ages ago into the wood to gather sticks. Having cut a fagot he slung it over his shoulder on a staff. On his way home he met a man in Sunday clothes walking toward church. "Do you know that this is Sunday on earth when all must rest from their labors?" he asked the wood cutter. "Sunday on earth, or Monday in heaven, its all one to me!" was the reply. "Then," said the stranger, "bear your bundle forever. And as you value not Sunday on earth, yours shall be a perpetual moon-day in heaven; you shall stand for eternity in the moon, a warning to all Sabbath-breakers." Whereupon the man with his staff and bundle was caught up into the moon, where he stands yet." (Proctor Myths and Marvels of Astronomy.)

Mr. Baring-Gould in his "Curious Myths of the Middle Ages," gives a slightly different version of the story, from Schaumberg-lippe, in which we are told that there is a woman with the man in the moon. The man is there because he strewed brambles in the church path on Sunday morning; the woman because she made butter on that day. A similar tale is told in Swabia and in Marken. He cites Frischart as saying that there "is to be seen in the moon a mannikin who stole wood." Among other German tribes it is told that he stole cabbages, or willow-boughs or sheep. With reference to the story in Great Britain, Harley cites Alexander Neckam, an abbot, born in 1157, who thus describes the popular belief: "Nonne novisti quid vulgus vocet rusticum in luna portantem spinas? Unde quidam vulgariter loquens ait,

> Rusticus in luna
> Quem sarcina deprimit una
> Monstrat per spinas
> Nulli prodesse repinas."

The following lines from the "Testament and Complaint of Creseide," whose authorship is sometimes ascribed to Chaucer, are spoken of Lady Cynthia or the moon:

> "Her gite was gray, and full of spottis blake,
> And on her brest a chorl painted ful even,
> Bering a bush of thornis on his backe
> Whiche for his theft might clime so ner the heaven."

According to Baring-Gould, the moon has always been associated with the idea of theft in the Norse mythology, and the figure seen in the moon came easily to be regarded as the thief. The Bible story of the stick-gatherer later supplanted the theft with Sabbath-breaking. How the idea of theft originally grew up in connection with the moon must, of course, remain largely conjecture, but the psychology of the process is not far to seek if we remember the statements of children at the beginning of the section. The idea that the moon knows what is taking place on earth is almost universal. This probably arises from the suggestion of an eye, and the moral effect is the same as in the ordinary statement, "God sees you." The majority of thefts are likely to have been committed at night, and the presence of the same spectator would establish a close line of association. This would also account for its being made an external conscience, because it would recall the former act and its associated moral quality.

6. Place of Departed.

Wherever the idea of the moon as a *place* has appeared, it has almost invariably become connected with ideas of spirit inhabitation. It is sufficiently familiar to stimulate, and sufficiently remote from certainty to permit the freest play of fancy.

Children from eight to fourteen or so, develop ideas of what is in the moon. A few think they can see people move in it; some think dense forests; small people live in it, or odd, fairy, dwarf or other fantastic personages, as people without heads or all head. Its population increases or decreases. It may be full of beautiful angels. Often there is much music made by the people, or by the moon and stars. God lives or sleeps there. The people keep the lamp, like light-house keepers; or brighten it by letting the sun shine through it; or clean off the dirt that we can see from its contact with black clouds. Old and crooked people, or the souls of the dead, or of babies live there. All its inhabitants are pale and rather sober and sickly. When it goes the other way, they will straighten up. Its weather is hot or cold as ours is, and it is often smoky. Some think it a penal colony of Sabbath breakers, or can see them behind prison bars. A girl was terrified, because when looking at its shadow in water, it seemed to shake. Frequently the face of a dead parent or dead friend shows itself.

F., 16. Used to think it a big eye glaring at her, and later heard it was full of dead people.

Any one of these suggestions, given a receptive and responsive environment, might easily grow into a definite belief about another world or future life.

The folklore stories vary considerably as to detail but have the same central idea. Just as with children it is the place of the unusually strange or unusually beautiful. Lucian the Greek satirist wrote a book on the "Voyage to the Globe of the Moon," in which he describes it as a great round and shining island which hung in the air and yet was inhabited. These inhabitants were of a most fantastic order, were called Hippogipians, and their king was Endymion. Others of the ancients thought the lunar men and plants were of an immense size. Generally, however, the moon as a place stands in a much closer relation to the earth, and becomes a sort of hades or receptacle for the departed. In the Egyptian "Book of Respirations," Isis breathes the wish that the soul of her brother Osiris might rise to heaven in the disk of the moon. Plutarch tells us that the moon is the element of souls which resolve into her as the bodies of the dead resolve into the earth. Johanna Ambrosius, the German peasant-poet, prays in one of her poems that when she dies she may spend eternity in the moon. Mr. Tylor tells us that the Saliva Indians, of South America, point out the moon as their paradise where no mosquitoes are, and the Guaycurus show it as the home of deceased chiefs and medicine-men, and the Polynesians, of Tokelaù, in like manner claim it as the abode of departed kings and chiefs. A common mediæval conception made the moon the seat of hell, and Plutarch mentions an ancient theory that hell is in the air and elysium in the moon.

This brings us to a circle of the most beautiful conceptions in the whole range of mythology, the paradise stories of the different races, in each of which the moon has played a more or less important role. The two things necessary in the construction of a paradise seems to be trees and brightness. Some among the ancients said that the bright patches on the moon's face were plains, and the lunar spots forests, Diana's hunting-ground. Captain Cook says that many among the South Pacific Islanders regard the moon-spots as splendid groves of trees which once grew in Otaheite, but are now extinct. Others, according to Ellis, suppose the moon is a beautiful country in which grows the aoa, the most stately object in a Tahitian landscape. We have already referred to the Greek elysium, the plain far in the west, with its asphodel meadows and eternal sunset sky, the isles of the blessed sailing in a sea of blue and wrapped in burnished clouds, the blissful land where Odysseus and Laertes, Achilles and Hector meet, and all enmities are forgotten. The paradise of the Pacific Islander is essentially the type of all the others, the Hindoo Meru, the Persian Heden, the Chinese garden, the Hebrew paradise, and the Christian heaven.

7. Emotional Reactions.

Its presence makes small children, three to eight and older, feel "nice," "happy," "jolly," "splendid," "good," and rarely "sad." They jump, shout, run, laugh aloud, lose their usual sleepiness, are usually good tempered and often excited to the point of abandon. The excitement of the light may almost intoxicate. Sometimes, at this stage, it is said to be not beautiful but just pretty, because so round, bright and large. Only older children gaze and languish.

F., 9. The moon makes me think of love, because the man and woman in it make love and will marry sometime.

F., 11. The moon is sad, because she is the sun's wife, and he is proudest and they do not live together.

F., 16. I go out on the piazza or further, when the moon is there, for I feel it will take care of me.

F., 17. I used to think of the moon as very tall, blonde, a lady, proud and cold, and feared by all the stars. Now, at sight of her, I want to be silent and have the old feeling.

F., 15. I thought the moon saw us and changed its expression while looking at us. I remember, about ten, lying abed and making faces at it. The more terrible faces I made, the more the moon smiled. This made me angry.

F., 5. I love to make faces at the man in the moon. He laughs and comes down and kisses me.

F., 16. Once I was looking at the moon and I saw the man in it smile. I ran and told mamma the moon man was laughing at me. But I watched and found he was always smiling, so I knew he was pleasant.

Eight other children think they have seen the moon smile or laugh.

M., 29. The sight of the new moon always gives me a thrill of pleasure, and causes me to smile. The feeling is so intense that often I feel my hands clinching, my body growing tense, and I utter an involuntary ah. I wish I could account for it.

F., 26. Moonlight, especially if I am alone, makes me sad. Is it my unworthiness and littleness at sight of the wonders of the heavens? I long to be more deserving of their blessings and beauties.

F., 20. Loves to sit and watch the moon and make all sorts of fancies about it; how it is the oldest and biggest star, but all are growing to its size; how it is their mother, and sometimes gets angry with her children; how I would like to go up there and what I would do; about trees, houses, flowers and people there; how I would swish on a swing hitched to it, etc.

M., 5. I want to go right up and fly round heaven with it. I always say, "Ah, pretty, pretty moon."

M., 7. When I see it bright and pretty it makes me feel good and nice. I want to go right up there, and feel as if I must go at once.

F., 8. I love it very much, so much that I want to visit it, and often get a lump in my throat.

F., 21. It is soothing, sympathetic and tender, and its light is so soft and mild that it must love everybody and everything. It makes me good and rests me. Sixteen children want to go up to the moon. It draws, or they want to see what it is made of, they feel homesick or long for it.

F., 19. Feels awe and wants always to be still, quiet and alone awhile with every moon, and sometimes stretches out her arms to it.

F., 13. Loves it, because she heard how it loved a weary mouse, a pair of lovers, a convict, some lost children and a belated traveller.

M., 5. Misbehaved, was scolded, sulked and went out on the porch, and was overheard to say, "old moon you might cover your face, so she would not have seen me," and a few moments later, "I will make all the faces at you I want to and you can't hurt me."

M., 5. Ran suddenly out doors to hide, in a game, and found a bright moon, and shouted "get out of the way, there, you saucy old thing, or I will give you a slap."

M., 15. Used to go out and talk to the moon if in a bad humor, told all her secrets and told him not to tell.

F., 18. The moon looked to me like a funny, puffy, little man, with fat cheeks, laughing from ear to ear, with small twinkling eyes, and a broad forehead much wrinkled. I used to tell him or wanted to tell him all the funny jokes I heard, especially about him, and ask him what sort of a time he had.

F., 18. Used to want to hug and kiss the moon, and once asked it to marry her.

F., 19. Never could endure to look at or even think of the moon if away from home. It made her homesick and intolerably sad, it seemed so cold and friendless up there.

F., 21. Still wants to cry and go off by herself, sit still and watch it and think.

F., 19. It has a strange fascination for me. I cannot take my eyes off it.

F., 18. When I see it clear and bright, I feel good, partly because I think we will have good weather. I would like to take a walk with my beau if I had one.

F., 12. I always want to go out walking or riding, or see some one.

M., 27. I never can bear to go to bed when the moon is at its best. It seems like wasting opportunity to do something, or at least to saying it.

M., 29. To be honest, I always think of the girls when it is moonlight, and where I would like to go and what do with one or another of them.

F., 19. I used to cling to mamma, now I feel sad but enjoy it in spite of my tears. I do not know why my heart goes out to it so.

As regards emotional reactions among primitive peoples, a single quotation from Mr. Tylor will suffice. "Negro tribes seem almost universally to greet the new moon, whether in delight or disgust. The Guinea people fling themselves about with droll gestures, and pretend to throw firebrands at it; the Ashango men behold it with superstitious fear; the Fetu negroes jumped thrice into the air with hands together and gave thanks."

8. Effect of Phases.

The monthly increase and decrease constitute, perhaps, the most obvious fact pertaining to the moon.

The quarters when noticed by children are variously explained. It is sometimes thought to be slowly made a part at a time, or the mice have eaten half; it is hammock shaped for the man in the moon to rock in, or to rock his baby in; there are several moons, wholes, halves, quarters, etc., it does only half duty or

loses part when the sun is out; it shows only part, or gets small when it is going to rain; or the part that is cut out goes to sleep and a part must be always on duty; new moons are just born or full ones are made out of worn out rims of old ones; it gets starved, thin and lean; it dies out and then comes to life again; the moon man draws the curtains part way or all the way when he goes to bed.

It eats, and you can see the teeth in its horseshoe mouth, or else its mouth is a mark on the full moon. Its chief food is cheese, but it also eats mice, stars, buckwheat cakes, cookies, and other round things so as to get round itself; or it eats pumpkins and lemons, because it is yellow or to get yellow; or catches birds; or eats pieces out of the sky; it eats off a big round and perhaps yellow table; and may eat bread, butter, oatmeal, candy, ice cream, drink milk out of a round cup. When it gets thin, it has done wrong and God withholds food. It may wear a mask and eat through that, drink up the rain or dew.

F., 29. Once thought things grew big and small, as the moon did.

The absence of the moon by day or by night is hard to explain, when noticed. Younger children think it is abed, undressed, asleep, etc., or that God had not hung it out. It relieves the sun as a night watchman, so it can go to bed, they arrange it between them so one shall be there. In storms or when we do not see it, it is shining in heaven on the other side of the sky or somewhere else, or the rain puts it out, or it retires to avoid darkness and storm. When it looks pale, it is just waking up, and has hardly got its eyes open. It may be behind the sun, while by night the sun is behind it. It gets very tired sometimes from the effort of shining, but more often from its journeys. It darkens the sky so it can sleep. One pictured the room it slept in, with a white bed, stove, lamp, etc. It shuts its eye so we cannot see it, and uses clouds for sheets and blankets. One could not conceive how it could know when to get up. It spends the night in the ground or in the water. When it does not shine, it is sick or the sun will not give it the light it begs for. God does not like to expose it to danger or dark and storm and shuts it up. Rain may wet it and give it cold.

Waxing and waning are reflected in nearly all the stories and are variously accounted for. In some it is the central fact to be explained. Two or three examples will suffice. Among the Khasias, of the Himalaya Mountains, it is told that the moon, who is a man, commits the unpardonable offense of falling in love with his mother-in-law every month. That commendable lady very properly reproves him by throwing ashes in his face. There is a similar legend of Slavonic origin in which the

moon is unfaithful to his wife, the sun, loving the morning-star instead, and for punishment is cut with a sword. Among the Greenlanders, the sun and moon were once human beings, sister and brother, named Malina and Anninga. The latter while playing in the dark, seized his sister by the shoulders, a sign of courtship. In order to recognize him, she smeared soot on his face which accounts for the spots. When she discovered who it was, she fled to the sky, becoming the sun, closely followed by Anninga, who became the moon. The chase at times makes him very hungry and thin, when he gives it up for a few days to hunt seals. This fattens him, and he becomes the full moon again. Among the natives of Encounter Bay it is told that the moon is a woman living a dissipated life among men, which causes her to grow very thin, whereupon she retires for awhile, or rather is driven away, to recover her plumpness, when she resumes her gay life. A well known savage myth is that in which the moon tells men through a beast that though they die, like her they shall live again.

The effect of the moon's phases on common folklore is almost inconceivable in extent. It stands always as the symbol of fickleness, especially of increase and decrease, growth and decay. It is only a short transition in association from the symbol to the cause, so the moon has exclusive control of all undertakings in which these factors enter in. Says Harley: "The *new moon* is considered pre-eminently auspicious for commencements,—for all kinds of building up, and beginning *de novo*. Houses are to be erected and moved into; marriages are to be concluded, money counted, hair and nails cut, healing herbs and pure dew gathered, all at the new moon. Money counted at that period will be increased. The *full moon* is the time for pulling down, and thinking of the end of all things. Cut your timber, mow your grass, make your hay, not while the sun shines, but while the moon wanes; also stuff your feather bed then, and so kill the newly plucked feathers completely, and bring them to rest. Wash your linen, too, by the waning moon, that the dirt may disappear with the dwindling light." From the Greeks down the new moon has been considered the proper time for marriages and births. Among the Druids, according to Forbes Leslie, "the moon, in the increase, at the full, and on her wane, are emblems of prosperity, established success, or declining fortune, by which many persons did, and some still do, regulate the period for commencing their most important undertakings." In Gealic the word for fortune is derived from that which means the full moon. Numerous superstitions exist as to the way the new moon must be first seen, with various incantations, and methods of prognosticating the future.

While dealing with the general question of the moon's influence upon human fortune, it may be well to refer to the wide-spread astrological superstitions pertaining to its effect upon the body. The chief organ that it governed was, of course, the brain, but it had a secondary control of several others. The words "lunacy" and "mania" are of direct derivation, and even now we speak of a person as being "moon struck." That all forms of insanity are traceable to this influence, is a very ancient belief. An interesting example of the ancient practice of medicine is given by La Martinière, quoted by Harley. "This lunar planet," says this author, "is damp of itself, but, by the radiation of the sun, is of various temperaments, as follows: in its first quadrant it is warm and damp, at which time it is good to let the blood of sanguine persons; in its second it is warm and dry, at which time it is good to bleed the choleric; in its third quadrant it is cold and moist, and phlegmatic people may be bled; and in its fourth it is cold and dry, at which time it is good to bleed the melancholic." The light of the moon seems to have been almost universally considered detrimental to health, and nearly all the maladies in the catalogue were within its power to inflict.

9. Moon-Worship.

To determine the necessary processes and fundamental stages in the development of a religion is the paramount problem in the new science of religions. Without involving questions as yet unsettled by investigators in this field, we may refer to certain generally conceded facts. One of these is that every religion is a *growth* involving a great complexity of elements. Again, it stands as the final output, so to speak, of a people's life, and is the ultimate organizing element in any particular period. After a more or less diffused growth, each of the great ethnic religions seems to have been summed up, recast, and individualized by a great personality. While it is possible to follow back the line of development and find elements that had been assimilated to a larger system, it is also, to some extent, possible to approach these elements from the side of their psychological beginnings. Thus the sex-instinct which even now stands so near to the religious sentiment, shows its enormous significance historically in the forms of phallicism so prevalent in some periods. It is, of course, one of the problems of psychology to determine what in the individual is the raw material of which religion is later made. The existence of an original religious instinct is altogether without evidence. As with races, so with individuals, it is a growth not only through childhood, but through the entire life. That children at an early age pray to the moon, is evident from many of the re-

ports, but just what a prayer means at this age is doubtful. Several thought the figure in the moon was God, or Christ, or angels. It is probable that the elementary feelings are a sense of familiarity, sympathy, responsiveness, and a desire for help. The following examples are illustrations of what is meant.

F., 18. I took great pleasure, aged twelve to fourteen, sitting by my window and telling the moon all my school girl troubles, and asking different things. He would smile and encourage me.

F., 11. I always want to talk to the moon, and sometimes do. I always say "shine on." F., 18, used to say, how do you do, aloud to the moon. F., 9, says, where are you going, aloud. M., 5, was heard to ask the moon its name. F., 7, used to say "I want you." F., 15, used to tell the moon all her troubles. F., 22, used to "tell and ask many things." F., 9, asked many questions and talked all about toys and dolls (she was an only and neglected child). When F., 19, first learned things, she used, as a child, teach them to the moon. F., 5, would sing and talk to the moon, and ask it to give her cake and ice cream, and beg it to come and play with her. Children pray the moon to shine, so they can see to go somewhere, or so they will not be afraid. "Take me with you" is another frequent invocation. To look over the right shoulder and wish for things is very common. F., 19. At six and eight, my sister and I were left alone till into the evening by our parents being delayed. We asked the moon where they were, and I shall never forget the strong impression of anxiety with which we watched to see if he would tell us.

It is an easy transition from the simple accounts of natural phenomena embodied in myths to the organization of these into more or less complex systems. Among these primitive formations one would expect to find unusual importance attached to myths of the sun and moon, the rulers of day and night, the most continuously present facts of man's natural environment. That this was the case among many peoples cannot be doubted. The ruins of many ancient temples abundantly attest the great antiquity of this form of worship. Some authorities maintain that luniolatry preceded the worship of the sun. Says Mr. Tylor, "Moon worship, naturally ranking below sun worship in importance, ranges through nearly the same district of culture. There are remarkable cases in which the moon is recognized as a great deity by tribes who take less account, or none at all, of the sun."

Among the ancient Egyptians the sun and moon worship seems to have been the earliest form of religion. There were two moon-gods, Khonsu and Thoth. All representations of these deities show them with the crescent, and Thoth was the keeper of time. The cat, well known as one of the sacred animals among the Egyptians, was dedicated to the moon. The sun and moon appear very frequently on ancient Assyrian monuments as sacred symbols. The Chaldeans were undoubtedly moon-worshippers, the names of the deity being Sin and Hur. The latter was also the name of the Chaldean capital.

The name for the moon in Syriac at the present time is Sin. Many think it appears in Sinai, and that this mountain was consecrated to the moon. The fact is very important in view of the part Sinai played in the Hebrew religion. But there is more positive evidence of the existence of luniolatry among the Hebrews. There is frequent reference in the Scriptures to the "host of heaven," to the "queen of heaven," to Astarte or Ashtaroth, the moon-goddess of the Phœnicians. Ancient writers, as Lucian and Herodian, identified the latter deity with the moon. There is reference in Genesis to Ashtaroth-Karnaim, meaning Ashtaroth of two horns. The symbol of Astarte was the heifer with the crescent horns, the worship of which continued almost throughout Hebrew history. The crescent was one of the most common of ornaments.

The personification of the moon among the Greeks crystallized in two well-defined myths, those of Selênê and Artemis, each characterized by that delicate and refined symbolism which gives its greatest charm to Greek mythology. Says Cox of the Selênê myth, "As Endymion sinks into his dreamless sleep beneath the Latmian hill, the beautiful Selênê comes to gaze upon the being whom she loves only to lose. The phrase was too transparent to allow of the growth of a highly developed myth. In the one name we have the sun sinking down into the unseen land where all things are forgotten—in the other the full moon comes forth from the east to greet the sun, before he dies in the western sky. Hence there is little told of Selênê which fails to carry with it an obvious meaning. She is the beautiful eye of night, the daughter of Hyperion, of Pallas or of Helios, the sister of Phoibos Apollon. Like the sun, she moves across the heaven in a chariot drawn by white horses from which her soft light streams down to earth, or she is the huntress, roving like Alpheios, over hill and dale. She is the bride of Zeus, and the mother of Pandia, the full orb which gleams in the nightly sky; or as loving, like him, the crags, the streams and the hills, she is beloved by Pan, who entices her into the dark woods under the guise of a snow-white ram. In other words, the soft whispering wind, driving before it the shining fleecy clouds, draws the moon onwards into the sombre groves."

The same writer says concerning Artemis: "In some traditions Artemis is the twin sister of Phoibos, with whom she takes her place in the ranks of correlative deities. In others she is born so long before him that she can aid Lêtô her mother at the birth of Phoibos—a myth which speaks of the dawn and the sun as alike sprung from the night. Thus her birthplace is either Delos or Ortygia, in either case the bright morning land, and her purity is that of Athênê and Hestia. . . . .

Like Phoibos, she has the power of life and death; she can lessen or take away the miseries and plagues which she brings upon men, and those who honor her are rich in flocks and herds and reach a happy old age. From those who neglect her, she exacts a fearful penalty. . . . . In a word the colors may be paler, but her features and form generally are those of her glorious brother. With him she takes delight in song, and as Phoibos overcomes the Python, so she is the slayer of Tityos."

According to Pansanias, there was a worship among the Greeks of the Egyptian goddess Isis, which, if we can trust Diodorus, meant the moon with them. That moon worship persisted to a very late period is shown by the words of Socrates, who said at his trial, "You strange man, Melêtus, are you seriously affirming that I do not think Helios and Selene to be gods, as the rest of mankind think?"

The chief moon-deity among the Romans was Luna, sister of the sun. Both Pliny and Tacitus speak of temples consecrated to her worship. Another moon-goddess was Diana, corresponding to the Greek Artemis: Grimm, the best authority on the ancient Germans, tells us, "That to our remote ancestry the heavenly bodies, especially the sun and moon, were divine beings, will not admit of any doubt." Moon-worship appears among the rites of the Druids in Britain and Ireland. Its prevalence in China and among the American tribes is well known. There can be little doubt that vestiges of luniolatry appear in the Christian religion. A definite order was formed about the fourth century. The lower classes in the middle ages openly worshipped the moon, identifying her with the Virgin. In the Missal Mary is spoken of as, "Sancta Maria, coeli Regina, et mundi Domina." These illustrations will be sufficient to show how important the moon has been in the development of the religious consciousness.

10. The Moon of Science.

This fragmentary outline may, perhaps, be sufficient to show that the moon has been the subject of one of the most profound chapters of human experience. As a central object in that environment of which it has been and is the business of man to make account, it has been a continual stimulus helping to call out and fix some of the most elementary affirmations of the mind. That these same affirmations not only appeal to, but arise spontaneously out of the growing instincts of the child is almost beyond doubt. It becomes then a matter of considerable interest and importance to note the stage of transition from the primary animistic and mythical conception to that made necessary by positive science. The moon furnishes the best

example in nature of a complete reversal of views. The transition is not so marked in the case of the sun which, on account of its manifold influences, stands as the type of perennial activity, or the stars and planets which with their great remoteness or possible inhabitation remain to some extent in the region of mystery and conjecture. But the facts concerning the moon, which science has assembled, deprives it of every vestige of anthropomorphic interest. We will recount a few of them.

The moon is our nearest neighbor, astronomically, its mean distance being 238,840 miles. Its diameter is 2,163 miles; surface $\frac{1}{13}$, and volume $\frac{1}{49}$ that of the earth; rotates on its axis once a month, in precisely the same time as required for revolution around the earth; phases due to fact that we can observe only that part of the illuminated hemisphere turned toward the earth at the time; light reflected, only $\frac{1}{15}$ as strong as earth-shine; atmosphere extremely rare, $\frac{1}{760}$ of pressure at earth's surface, probably absorbed in cooling; no water, also absorbed; temperature at end of lunar day about freezing point of water, at end of lunar night, 200° below zero; no signs of life. The surface is very broken; covered with great volcanic craters, some of which are more than 100 miles across; twelve great plains, called seas by Galileo; many deep valleys and cracks; some mountains reaching the height of 23,000 feet.

It stands as the great example of a worn-out world, and the type of what our own planet will ultimately become. The passage from the conception that treats the moon as a living personality with multiform influences upon human weal and woe to that in which it appears as only a dead stone, must necessarily be attended by much that is pathetic, because it marks the disintegration of one attitude toward nature and the inception of another. Every *eclaircissement* is a period of criticism and disruption. The historical counterpart of what appears in the life of every individual is to be found in the Greece of the Sophists and Socrates. The very statement that man is the measure of all things implies the realization that he has already lost his standard. The balance struck by Plato between the old mythology and the new critical attitude is perhaps the reason of his significance as the philosopher who most truly reflects the meaning of life. For us his work is important as showing the impossibility of destroying an attitude based in the evolutionary series and standing as the ultimate outcome of a whole people's existence. The same reversion can be noted in every other period of "enlightenment." Along with it always goes a marked treachery to the principle it is trying to establish. The most convenient lesson probably which modern man has learned, is that of dividing his experience into sep-

arate compartments connected by blindfold passages. In one he keeps his rationalism, in the other the more neglected and, in some respects, the more important parts of his experience. A good example of what is meant is the enlightenment of the eighteenth century. A thoroughgoing mechanical scheme was good enough for the visible universe, but beyond it was that quintessence of the mythological heritage, a *deus ex machina*. That this is still the position of many, needs no more than to be indicated. It is more than suggestive that the chief impulse in the development of biology came from the impossibility of longer accepting the creationalistic mythology. The science of life undoubtedly appeals to something more fundamental in human nature than the mere desire to know. This development from mechanism to organism suggests the true direction the animistic instinct should take—that is, it should become a motive within science itself. The lesson of history is but partially learned if we fail to perceive that an *eclaircissement*, whether in individual or racial life, is nothing more than a momentary disruption preliminary to a new adjustment, and a disruption that might in most cases be avoided. After all, the raw material of knowledge, even scientific, is not externally gathered, but to be found within man himself, made by a process of development into established forms. An excellent illustration of what it meant is the subject we have attempted to treat. The moon, considered solely with reference to itself, has been before the human mind from the beginning just as it is now. It has been, so to speak, a fixed point about which human nature has made its revolutions. It would seem, to be sure, that science has brought all such movements to a complete stop, but the moon-lover need not be pessimistic. He should remember that the romantic attitude toward nature came directly from the heart of the mechanicalistic movement, and, while Schelling could no longer be accepted, the last century showed the most genuine feeling for nature known since the Greeks. If the animistic instinct cannot surmount a wall, it is likely to find a way around it. Even now, it means no more to the person of deep æsthetic feeling to say that the moon is a barren body of matter than that a landscape is composed of inanimate objects, or a symphony of vibrations, or a painting of canvas and pigment. Again, the meaning of matter is by no means clear as yet; its supposed deadness may be merely accidental. If one wished to press the question, he might insist with some justification that the characteristic concepts of science are ultimately mythological agencies. Certainly some of them are not distant many removes. Our sole object here, and indeed the whole value of the study, if it has any, is to show the complete relativity of an object in nature

when viewed from the standpoint of psychological development, and the mobility of the supposedly fixed environment in the actual experience of it, to which it must be referred if it is to have meaning as environment.

The writer wishes to express his obligation to Dr. G. Stanley Hall, who began the study some time ago, for kindly supplying much material he had collected, and also for constant advice and assistance in carrying the article to completion.

LITERATURE.

Outlines of Metaphysics, by J. S. MacKenzie. Published by Macmillan and Co., New York and London, 1902.

The book is a study of the problems of metaphysics from the standpoint of the philosophical thought of the day. It centers round the problems relating to experience, and advances a step on Bradley in that it is enabled through its use of the genetic method to gain through the idea of the becoming of experience a new light on experience, not more experience, perhaps, but more significance in experience. And then after a thorough study of experience by the genetic method, bringing out all its phases, he studies the forms of the constructive activity, as they build up their interpretations of experience, from the standpoint of the whole of experience.

The work opens up with a provisional definition of metaphysics, namely, it is the science that seeks to deal with experience as a whole, or rather as a systematic unity. After discussing the special sciences, showing how all deal with only a part of experience, he changes his definition of metaphysics by saying metaphysics is the science which seeks to take a comprehensive view of experience with the view of understanding it as a systematic whole, by experience understanding the experience of an individual yet an experience common to all, individual yet universal. With the seeming fundamental duality of experience, of subject and object, mind and matter, and on the other hand with its equally seeming unity arises the first great problem of metaphysics, namely, that of their reconciliation. Some attempts have been Dualism, Inonism, Agnosticism, Materialism, Idealism, Transcendentalism. What we want, says MacKenzie, is not a Theory of Knowledge but a Theory of Experience. What we want, then, is a method which will enable us to arrive at the solution of our problem mentioned above. (a) Early dialectic method, (b) dogmatic method, (c) psychological method, (d) critical method, (e) later dialectic method have been tried and found wanting, and since we want to study experience from the point of view of its becoming as well as what it becomes, and also since it was the method led up to by the development of both ancient and modern philosophy Aristotle and Hegel; and since it keeps us in touch with the concrete content of experience the genetic method seems by far the best; therefore it will be our method. We wish to consider 1st the genesis of experience, asking two questions: (a) how does experience of a world grow up? (b) the significance of the various elements in its development? Before answering the two questions let us restate our problem. The problem is to try to understand the general significance of our experience as a whole by observing the process of its development. In answer to the first question we would say, we have (a) the simple emergence of a manifold content in consciousness.

This content is always somehow presented within a unity but there need not be any conscious reference to such unity, the presence of the unity being shown in that the content presented is not bare or cold but has always an effective side, (b) this consciousness of harmony or dissonance is seen, on reflection, to be connected with changes that take place from within in the content of our experience. In answer to ques-

tion two we have the three elements (a) simple presentation in consciousness, (b) feeling, (c) conscious activity; simple presentation being the most significant in the first stage, feeling in the second stage, conscious activity in the third stage; and, as the third stage is the most important, and since it is to thought experience we must hope for metaphysical enlightenment, conscious activity is the most important and most significant element. The three stages of development are (a) sensation, (b) perception, (c) conception. Nine problems seem to be involved in sense-experience, seven in perception, four in thought. While all the problems of the two lower stages are involved in the highest stage (thought), the advantage of rising to this problem through a genetic study lies mainly in the fact that it enables us to put the whole of our material before ourselves in proper perspective. Metaphysics is the criticism by thought of its own constructions, thought being considered as the culminating point in the general process of experience. The chief value of a genetic survey lies chiefly in the fact that it enables us to have definitely before our minds a connected view of experience as a concrete whole. Again it abolishes the fundamental distinction between mind and matter, and the apparent fundamental antithesis between apparent duality and equally apparent unity of experience, for both the world of mind and matter are ideal constructions. What we have to do is to take mind and matter as elements in the totality of our experience and try to see what place belongs to each within the concrete system of our world. Most fundamental antithesis is that between the That and the What. Yet nowhere in our experience have we pure Thatness or pure Whatness. The development of experience is from the less to the more determinate by the introduction of more and more definite constructive forms. We have certain constructive activities involved in experience. As it is, the problem of metaphysics is that of considering and criticising the whole work of these.

Accordingly, the question for metaphysics is (a) What are the fundamental forms of construction in the building up of our experience? (b) How far is each of these forms coherent in itself and capable of being worked out? The forms of construction are (1) Perceptual, (2) Scientific Construction, (3) Ethical Construction, (4) Æsthetic Construction, (5) Religious Construction, (6) Speculative Construction. The second question is answered in particular in the remaining part of the book and his conclusions summed up as follows. There are certain difficulties in the constitution of human knowledge but at the same time there are indefinite possibilities of gradually removing such difficulties, or at least reducing them to a minimum. Take any construction by itself and it fails, take it in relation to the whole, for experience is an organic whole, and we may reasonably believe it does not fail. The book I wish to commend very highly, 1st because it realizes the ideal Prof. MacKenzie had in mind when he wrote it, for it was to be a book for the student just beginning seriously to face the problems of metaphysics. It lays out the problems in a clear manner before the student so that he knows what he faces and from what sources these problems rise. 2nd, for his use of the genetic method, the best possible method to gain a complete insight into the significance of experience. 3rd, for his recognition of the claims of all the constructive activities contained in experience. The plan of the book is admirable. It is the best book of its kind I have ever come in contact with. My only criticism would be that Dr. MacKenzie in one or two places has asked questions and then failed to give definite answers. He seems to have wandered away into something else. R. M. MOORE.

Kant's Prolegomena. Edited by Dr. Paul Carus. Published by Open Court Publishing Company, Chicago, 1902.

A new translation of Kant's Prolegomena, by Dr. Paul Carus, with

an Essay on Kant's Philosophy by Dr. Carus, and supplementary materials for the study of Kant's life and philosophy, consisting of estimates of different phases of Kant's philosophy by Windleband, Weber, Schwegler, Lange and others. An exceedingly valuable book, enabling us to grip the essentials of Kant's philosophy. Dr. Carus has rendered a great service to English students of Kant in this book.

Leibniz Discourse on Metaphysics, Correspondence with Arnauld, Monadology. Translated from the originals by Dr. George R. Montgomery. Published by the Open Court Publishing Co., Chicago, Nov.–Dec., 1901.

Dr. Montgomery, by translating these parts of Leibniz's works, has enabled the English student of philosophy unable to read French, to study the Leibnizian philosophy from the genetic standpoint, thereby enabling him to grasp the true significance of the monadology through a study of his earlier writings. The translations are exceedingly well done, and the introduction by Paul Janet illuminates the pages following.

A Scientific Philosophy the Harbinger of a Scientific Theory; or, Steps to Philosophical and Theological Unity. Swan Sonnenschein and Co., London, 1901. pp. 241.

The writer's effort is to show that the old Scottish philosophy of common sense which proclaims an objective reality can be satisfactorily established on scientific principles; and secondly and chiefly, that the doctrines of Holy Scripture, duly interpreted, can be made to rest on and be consistent with the self same principles. Causality is the test of science. With this end in view, God, sonship, the origin and removal of sin, the soul, freedom, causality, election and predestination, priesthood, and the Lord's Supper are discussed.

A Primer of The Christian Religion. Based on the Teaching of Jesus, Its Founder and Living Lord, by GEORGE H. GILBERT. The Macmillan Co., New York, 1902. pp. 76.

This primer, we are told, and the whole Gospel is a primer, seeks only to turn the reader's thoughts to the great events and to the main features of the life and teachings of Jesus. It speaks the language of the school, and treats of Jesus, God, spirit, the kingdom of God, following Jesus, the Bible Sunday and the hereafter. The whole is put in eighty-five questions printed in red, each with a concise answer, evidently for memorization, with a few proof texts and generally a note.

The Menopause, by ANDREW F. CURRIER. D. Appleton and Co., New York, 1897. pp. 309.

Although this work is not exactly new, it is so excellent and compendious and so supersedes Tilt's well known book upon the same subject, that it deserves brief mention.

Die Entwicklung der Religionsbegriffe als Grundlage einer progressiven Religion, von STEFAN von CZOBEL. Lotus-Verlag, Leipzig, 1901.

This is the last half volume of a work briefly characterized in a former number of this *Journal.* This is devoted to morals, external cult and priesthood.

Der Gesang der Vögel, seine anatomischen und biologischen Grundlagen, von VALENTIN HAECKER. Gustav Fischer, Jena, 1900. pp. 102.

In this interesting and important work, the writer treats first of the

structure of the vocal organs of birds. He then discusses at length sexual dimorphism. Most interesting, perhaps, is the third chapter on the development of the singing instinct in its various forms. He then treats other courtship phenomena—drumming, tumbling, playing, mock fighting, etc. Finally, he discusses the development and significance of the courting instinct and the relations between reflexes, instinct and play, and ends with a good nomenclature.

Les Arts et Métiers chez les Animaux, par H. COUPIN. Nony & Cie, Paris, 1902. pp. 422.

This ingenious and industrious writer has collected from many sources accounts of the industries of animals, which he classifies as masons, potters, weavers, paper makers, cotton makers, mound builders, road and bridge makers, sewers, wax moulders, rosin makers, tapisers, miners, basket makers, wheel makers, confectioners, cigar makers, hammock makers, comb makers, spinners, architects of houses of amusement, carpenters, hut builders, ditch makers, stone borers, etc.

La Logique chez l' Enfant et sa Culture, par FRÉDÉRIC QUEYRAT. F. Alcan, Paris, 1902. pp. 157.

This naturally follows the two earlier works of the author on "Imagination and its varieties in children" and "Abstraction and its rôle in education." First comes the logic of images with examples seen in their comparisons and the construction of phrases and propositions, personification and anthropomorphism. Analogical reasoning is thus the first type. Child sophisms are classified under induction (mainly those of insufficient data, errors concerning causes and sophisms of accidence) and deduction or a begging question, and ignorance of the subject and vicious circle. The chief faults of children might be characterized as due to credulity, candor, naïveté, folly, precipitation, prejudgment, irreflection, sentiment and imagination. The last chapter praises the importance of rational training.

Der Selbstmord im kindlichen Lebensalter, von A. BAER. G. Thieme, Leipzig, 1901. pp. 84.

A member of the council of public hygiene in Berlin here ably sums up the history of the statistics of suicide of youth in France, Italy, and especially Germany, and draws therefrom important lessons. He holds that the chief cause is not to be found in the school, although he would relieve it from over pressure and especially from the worry of examinations, to which some cases especially in the lower schools can be directly traced. The chief cause to him is precocity or the premature development of an adult sense of responsibility, altruism or knowledge, and finds it most frequent in the lowest and in the highest stages of society, or better among the poorest and the richest strata of society. Of twenty-five interesting cases, he has himself made a special study. It is extremely desirable to have data on this subject collected with the same care for Anglo-Saxon races.

The Four Temperaments in Children. Their Appearance and Treatment in Rearing and in the School. As Appendix: The Temperament of Parents and Teachers. By BERNHARD HELLWIG. J. Esser, Paderborn. pp. 79.

This is an interesting characterization of each of the four phrenological types of childhood—the sanguine, choleric, melancholic, and phlegmatic. The treatment proper to each type is considered, and there is an appendix on the temperament of parents and teachers. Whatever we may think of phrenology, this book is of much interest and value.

Mental Growth and Control, by NATHAN OPPENHEIM. The Macmillan Co., New York, 1902. pp. 296.

The writer discusses in successive chapters the growth of character; mind as a machine; the power of attention; what association means; the uses of instinct; memory and its development; the bonds of habit; hypnotism and suggestion; imagination, the enlightener; the emotions and their education; reasoning, the guide; will, the controller.

Les Caractères, par FR. PAULHAN. F. Alcan, Paris, 1902. pp. 247.

The author here shows the different manifestations which abstract laws produce in different psychic types. His conception is new and personal, and he holds that the study of forms of character is attached to abstract psychology. He undertakes to classify individual types. The first edition of this work was long since exhausted, and here various objections are met.

Einleitung in die theoretische Biologie, von J. REINKE. G. Paetel, Berlin, 1901. pp. 638.

In the first section, the author treats of the relations between biology and philosophy; in the second, he discusses necessity in biological events; in the third, the forces and laws that work in organisms; then elementary organisms, heredity, and voluntarism and the mechanico-psychic view of life.

The Primitive Family in Its Origin and Development, by C. N. STARCKE. D. Appleton and Co., New York, 1901. pp. 315.

The writer treats at great length the definition of kinship among primitive people in Australia, America, Africa, Asia, Polynesia, and among the Aryans. He then addresses himself to his theme, and treats father and child, polyandry, the levirate and the niyoga, inheritance by brothers, nomenclatures, exogamy, endogamy, marriage and its development, family, tribe and clan.

Some First Steps in Human Progress, by FREDERICK STARR. Chautauqua Assembly, New York, 1901. pp. 263.

This tasteful little book is amplified from Chautauqua lectures and treats fire making, food getting, basket and pottery, hunting, the cultivation of plants, domestication, man of the stone age, metal working, weapons, dress and ornament, houses, boats, carts and sledges, gesture and speech, writing, tales and traditions, marriage and family, religion, the dead man, custom and law.

Nouvelles Observations sur un Cas de Somnambulisme avec Glossolalie, par TH. FLOURNOY. Ch. Eggiman et Cie, Genève, 1902. pp. 255.

The author here collects phenomena from Miss Smith after the publication of "Des Indes," and discusses the astronomic and oriental cycles and makes important inferences concerning the supernormal.

A Complete Exposé of Eddyism, or Christian Science and the Plain Truth in Plain Terms Regarding Mary Baker G. Eddy, Founder of Christian Science, by FREDERICK W. PEABODY. An address delivered at Tremont Temple, Boston, August 1, 1901. pp. 68.

The author was the counsel in a recent widely reported trial involving the principles of Christian Science. He deserves great credit, both for his fearlessness, for the vigor of his investigations, and for printing this very frank and lucid book, which all interested in the subject should read.

Lewis G. Janes: Philosopher, Patriot, Lover of Man. James H. West Co., Boston, 1902. pp. 215.

These papers by one of the leading modern free thinkers, dedicated

to the author's known and unknown friends, are grouped under the following leading heads: tributes by the Greenacre School, by the Cambridge Conference, by the Brooklyn Ethical Association, the Free Religious Association, and letters and other tributes. A list of his writings is appended, and there are five illustrations.

L'Occultisme et le Spiritualisme, par G. ENCAUSSE. F. Alcan, Paris, 1902. pp. 188.

After treating the psychology of occultism, astral body, consciousness, etc., the writer discusses its logical method and the relations of the soul to the microcosm or universe. Then follow the metaphysics, morals, traditions, sociology, etc., of occultism.

A Syllabus of Psychology, by H. HEATH BAWDEN. Vassar College, Poughkeepsie, N. Y., 1902. pp. 109.

This little manual endeavors to utilize the results of experimental and genetic methods, but the writer is principally interested in the larger aspects of the problem. To our thinking, the author has not escaped the danger of all abbreviated treatments and is somewhat too abstract for pupils of the age intended. The genetic aspect is very inadequately treated, and there is no evidence in the volume that the author is familiar with its literature.

Ophthalmic Myology, a Systematic Treatise on the Ocular Muscles, by G. C. SAVAGE. Gospel Advocate Publishing Co., Nashville, Tenn., 1902. pp. 589.

This compendious work, with sixty-one illustrative cuts and six plates, opens with a chapter on the fundamental principles of ocular motions, which will interest every working psychologist. It states in terms, often new and always clear, the law governing the recti and the obliques, innervations, the law of rotation to vertical and horizontal fixed planes of the head, the law of corresponding retinal points, the law of direction to individual muscle and its plane of rotation, with suggestive figures.

Die Welt als That, von J. REINKE. G. Paetel, Berlin, 1901. pp. 504.

The author first discusses the subject and the object of the investigation of nature; then the world stage, including sun, moon, history of life, force and matter; the essence of life; growth, irritability, propagation, adaptation and intelligence; Darwinism, including Weismann and Nägeli; and the relations of natural science to the God idea.

Études Esthétiques, par GEORGES LECHALAS. F. Alcan, Paris, 1902. pp. 306.

In the introduction, the writer treats of the beautiful and the ugly; and then in successive chapters passes to the discussion of what is art, its relations to nature, to mathematics, the role of suggestion in art, the affinities and associations to different arts, its relation to curiosity and to morals.

Typical Modern Conceptions of God or the Absolute of German Romantic Idealism and of English Evolutionary Agnosticism, with a Constructive Essay, by JOSEPH A. LEIGHTON. Longmans, Green and Co., New York, 1901. pp. 190.

This work originated in a Cornell thesis seven years ago. The original paper dealt only with Fichte and Hegel. Here Schleiermacher and Spencer are added. Each have a chapter, and in the fifth the author sums up his own conclusions. The absolute is the experienced unity of will and thought.